26.

Great Shades

Don't!

Don't say

percent of agreement

Sotopo-inductive

Poem

Book material

Ernest Shively
and
Russell Jenkins

Ernest Shively

Ruth Wolford

Jade - generalization - general report
Hornbill - Sodalite Elements.

$\frac{15}{12} = x$

$12x = 15 - 8$

$x = 1.25$

$48 = \frac{ma}{ca}$

$Eq = \frac{Ea}{ca}$

1.25 =

$1.25 = 13.5$

$12x = 15$

$x = 1.25$

13.5

48

1.00 = 12

12 = 12

$1 = \frac{15}{13}$

$x = 15$

48 - 48

Rock - ordinary

D-daffodil yellow

16
17
8
9
85
10

VIEWPOINTS
IN
EDUCATIONAL PSYCHOLOGY

The Century Education Series

VIEWPOINTS IN EDUCATIONAL PSYCHOLOGY

A BOOK OF SELECTED READINGS

BY

EDWARD HERBERT CAMERON, Ph.D.

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UNIVERSITY OF ILLINOIS

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PREFACE

This book of readings in educational psychology has been prepared to meet the need that many teachers feel of material to supplement the regular textbook. The attempt has been made to select a number of topics that have been treated somewhat distinctively by the various writers from whose works the readings have been taken. These topics are presented at considerable length in each case, the aim being to treat the subject adequately rather than to select a large number of short statements about many topics.

The chapter headings and order of arrangement follow the plan of my *Educational Psychology,* with the exception of Chapter VIII, which deals with "Mental Development" rather than with "Kinds of Learning," the chapter heading of the textbook.

My thanks are due to the writers of the selections included in the book for their generous responses to my requests for permission to reprint, and especially to the publishers owning the copyrights. The large amount of material taken from the writings of Professors C. H. Judd and E. L. Thorndike makes it appropriate to express especial thanks to these leaders of educational thought for their assistance.

E. H. Cameron.

Urbana, Illinois

EDITOR'S INTRODUCTION

Instructors of educational psychology, regardless of the textbook used, find the problem of suitable and adequate supplementary reading matter for their students exceedingly trying. Even in our largest university libraries, not only are references to articles or volumes or to chapters in volumes dealing specifically with the sub-topics under consideration difficult to find, but the number of copies available, in the vast majority of cases, is so limited that large classes find it impossible to use the reference effectively. In the smaller libraries, few references are actually to be found. The result is that the teacher, in many cases, finds himself compelled to confine the actual reading of the student to the text in use. Even where it has been deemed practicable to compel the student to purchase two texts, the teacher still finds it impossible to secure the necessary familiarity both with the ideas under consideration and with the literature concerning them. If these statements were not almost obviously true, Professor Cameron's experience in bringing together the large group of selections found in this volume would justify one in the enthusiastic belief that this volume, as now submitted to the public, constitutes a very real addition to the working material for the student of educational psychology. By using this volume, any instructor of educational psychology will find it possible to supplement the work of the text with more detailed presentations of specific subjects under discussion—in many cases, in the language of individuals who are masters of these particular topics.

Educational psychology will, for many years, be presented from the points of view of different psychological schools. The subject, itself, is of such a nature that it is hardly to be expected that our most serious students will reach identical conclusions. There is always an opportunity for varying and sometimes antagonistic points of view. While the author of an adequate text in educational psychology may be expected to undertake as a part of his problem some presentation of varying points of view, he, if he

is a genuine student of educational psychology, is almost sure to present more effectively the theories which he himself considers most acceptable. With such a book of readings as this to supplement the text, an instructor will be justified in assuming that his students will not leave his course one-sided in their knowledge of the conflicting theories or the varying modes of attack upon controversial problems. Because typical illustrations are available to be considered either at the actual time of studying the topic itself or in close juxtaposition with this study, the instructor of educational psychology should find this problem of presenting his subject adequately to the student greatly simplified by the opportunity to supplement it with this volume.

CHARLES E. CHADSEY.

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CHAPTER I

THE NATURE AND SCOPE OF PSYCHOLOGY

One of the difficulties which the study of psychology presents is that of defining its precise nature and scope. It is both natural and logical to define psychology in the way implied by the literal meaning of the word, namely, as the science of mind. Mind in turn would then be defined as the sum total of those conscious processes such as perceptions, ideas, feelings, and emotions, which in any one individual have a certain unity that warrants us in using a single word, *mind,* in referring to them. Psychology as thus defined is a science dealing with subject-matter, wholly unique and in contrast to the phenomena dealt with by the physical sciences. It is the science of conscious processes, as related to other conscious processes and with no reference to physical phenomena.

If psychology is thus defined and its subject-matter limited to conscious processes and their relationships to one another, there is but one method of observation that may be employed, namely that of *introspection,* the direct observation of one's own mental processes as they occur.

1. SCIENTIFIC METHOD *

"Scientific method may be summed up in a single word 'observation'; the only way to work in science is to observe those phenomena which form the subject-matter of science. And observation implies two things: attention to the phenomena, and record of the phenomena; that is, clear and vivid experience, and an account of the experience in words or formulas.

"In order to secure clear experience and accurate report, science has recourse to experiment. An *experiment is an ob-*

* Titchener, E. B., *Text-Book of Psychology.* By permission of The Macmillan Company.

servation that can be repeated, isolated and varied. The more *frequently you can repeat* an observation, the more likely are you to see clearly what is there and to describe accurately what you have seen. The more strictly you can *isolate an observation,* the easier does your task of observation become, and the less danger is there of your being led astray by irrelevant circumstances, or of placing emphasis on the wrong point. The more widely you can *vary an observation,* the more clearly will the uniformity of experience stand out, and the better is your chance of discovering laws. All experimental appliances, all laboratories and instruments, are provided and devised with this one end in view: that the student shall be able to repeat, isolate and vary his observations. . . .

"The method of psychology, then, is observation. To distinguish it from the observation of physical science, which is inspection, a looking-at, psychological observation has been termed introspection, a looking-within. But this difference of name must not blind us to the essential likeness of the methods."

[Titchener, E. B., *Text-Book of Psychology* (The Macmillan Company, New York, 1909), pp. 19, 20. By permission.]

However, many psychologists disagree with the view that psychology should deal *merely* with conscious processes and their relationships to one another. Psychology is the science that deals not only with conscious processes, but also with all accompanying and related phenomena.

This standpoint leads to the conception of a psychology which stresses the *function* of conscious processes, and, therefore, relates psychology to the biological sciences. The next excerpt expounds this point of view.

2. THE PSYCHOLOGIST'S STANDPOINT

"In our study of mental processes we shall adopt the biological point of view just now dominant in psychology, and regard consciousness, not as a metaphysical entity to be investigated apart from other things, but rather as one among many manifestations of organic life, to be understood properly only when regarded in connection with life phenomena. We shall discover,

as we go on, abundant reason for the belief that conscious processes and certain nervous processes are indissolubly bound up with one another in the human being. But at this point, without attempting to justify the assertion, we may lay it down as a basal postulate that the real human organism is a psychophysical organism, and that the mental portion of it is not to be completely or correctly apprehended without reference to the physiological portion. The psychophysical organism is, moreover, a real unit. The separation of the mind from the body which we commonly make in thinking about them is a separation made in behalf of some one of our theoretical or practical interests, and as such, the separation is often serviceable. In actual life experience, however, the two things are never separated. Therefore, although our primary task is to analyse and explain mental facts, we shall attempt to do this in closest possible connection with their accompanying physiological processes.

"Our adoption of the biological point of view, while it implies no disrespect for metaphysics, will mean not only that we shall study consciousness in connection with physiological processes wherever possible, but it will also mean that we shall regard all the operations of consciousness—all our sensations, all our emotions, and all our acts of will—as so many expressions of organic adaptations to our environment, an environment which we must remember is social as well as physical. To the biologist an organism represents a device for executing movements in response to the stimulations and demands of the environment. In the main these movements are of an organically beneficial character, otherwise the creature would perish. Mind seems to be the master device by means of which these adaptive operations of organic life may be made most perfect. We shall consequently attempt to see in what particulars the various features of consciousness contribute to this adaptive process. Let it not be supposed that such a point of view will render us oblivious, or insensitive, to the higher and more spiritual implications of consciousness. On the contrary, we shall learn to see these higher implications with their complete background, rather than in detachment and isolation."

[Angell, J. R., *Psychology* (Henry Holt and Company, New York, 1904), pp. 6, 7. By permission.]

The functionalist's point of view in psychology which has been set forth in the preceding extract from the writings of Angell is to be contrasted with the purely introspective point of view because of its skeptical attitude toward the value of introspection as a *sole* method of observation; its emphasis on the essential unity of body and mind (psychophysical organism); its emphasis on the importance of the study of the nervous system and of behavior; and its contention that consciousness has the function of aiding the organism in adapting itself to environmental conditions.

The behavioristic point of view carries the departure from the purely introspective view one step further. For the behaviorist introspection is valueless. Conscious processes, if they exist, have no relationship to behavior. Hence psychology becomes the study of behavior but without any reference whatever to consciousness.

3. THE BEHAVIORIST'S POSITION

"Psychology as the behaviorist views it is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness. The behaviorist attempts to get a unitary scheme of animal response. He recognizes no dividing line between man and brute. The behavior of man, with all its refinement and complexity, forms only a part of his total field of investigation. . . .

"Psychology has failed signally during the fifty odd years of its existence as an experimental discipline to make its place in the world as an undisputed natural science. Psychology, as it is generally thought of, has something esoteric in its methods. If you fail to reproduce my findings it is not due to some fault in your apparatus or the control of your stimuli, but it is due to the fact that your introspection is untrained. The attack is made upon the observer and not upon the experimental setting. In physics and in chemistry the attack is made upon the experimental conditions. The apparatus was not sensitive

enough, impure chemicals were used, etc. In these sciences a better technique will give reproducible results. Psychology is otherwise. If you can't observe 3–9 states of clearness in attention, your introspection is poor. If, on the other hand, a feeling seems reasonably clear to you, your introspection is again faulty. You are experiencing too much.

"The time seems to have come when psychology must discard all reference to consciousness; when it need no longer delude itself into thinking that it is making mental states the object of observation."

[Watson, J. B., *Behavior, an Introduction to Comparative Psychology* (Henry Holt and Company, New York, 1914), pp. 1, 6–7. By permission.]

The weakness of the behavioristic position is that it ignores the existence and influence of conscious processes in behavior, and therefore does violence to the facts. The non-behavioristic psychologist is not afraid to give up consciousness, but the facts of consciousness persist in making themselves known, and their influence felt. It may be freely admitted that their existence increases the difficulties, but shutting one's eyes to the facts merely oversimplifies the problem without solving it.

4. THE IMPORTANCE OF CONSCIOUSNESS

"The ordinary man is first aware of his conscious experiences and only very remotely aware of his nervous system. It is for this reason that man has been disposed to treat his conscious life as a reality apart from other realities. Consciousness is, indeed, the only reality open to direct introspective observation. When, on the other hand, the student approaches consciousness from the objective side and notes how the higher nervous organizations are gradually evolved from a long series of lower forms, he is sometimes baffled to find in the evolutionary scheme any place for consciousness. The active processes of animals develop in successive degrees of complexity from the reflex movements of the lowest animals provided for in the lowest forms of the nervous system, up to the most elaborate purposive movements of an intelligent man. It seems easy to adopt a purely mechanical explanation for the lower processes and to pass from

this mechanical explanation of reflexes without interruption to a mechanical explanation of the most complex forms of behavior. The presence of consciousness is more or less of an embarrassment to one who takes this view of behavior, for it tends to delay the easy progress of his explanation from the point of reception of the stimulation to its point of motor discharge. The result is that the student of the human nervous system often disregards consciousness and looks upon the neural series as complete without reference to experience, or at most he admits the experience series as a parallel but inefficient train of processes.

"The student of psychology cannot overlook the relation of consciousness to neural processes as does the ordinary observer, nor can he be satisfied to ignore consciousness, as is sometimes done in science. He must consider the facts with a view to both the objective and subjective demands. It seems to be true that the lower animals have little conscious experience; their nervous structures are very dependent on external forces which initiate and control action to such an extent that the whole life of the animal is controlled directly by the external excitations which act upon its organs of sense. As we ascend the scale, the function of neural transmission is supplemented in ever increasing degree by the function of internal organization. The significance of this internal organization may be expressed by the statement that the animal becomes more and more organized and individuated. When a stimulus acts upon a highly individuated animal, the effect of the stimulus sooner or later comes back into the outer world in the form of a muscular movement, but the form of muscular contraction is determined in relatively large measure by the internal structure of the animal and only in a small degree by the external stimulus. What has been said about individuation has its most complete exemplification in those highest animals which are possessed of cerebral centers for the indirect associative organization of sensory impulses. In man, for example, the path of transmission from sensory impulses to the muscles is so long and devious that the path is incomparably more important than the impulse which travels along it. In fact, transmission is here swallowed up in a process of organization so elaborate and complete that any scientific study of man will be obliged to lay its greatest emphasis on the

organs and processes of association and fusion, not neglecting, to be sure, the organs of reception, transmission, and movement, but regarding them all as subservient to the higher forms of organized central activity.

"With the evolution of higher forms of internal organization, there has come into the world a unique system of facts which we designate as the facts of individual experience. These individual experiences depend upon all the conditions which surround individual life, but they are more than these conditions. The analogy which helps us in understanding this statement is the analogy of life in general. There are certain physical and chemical agencies necessary to the development of life, but life must be treated as a unique combination of these agencies. The recognition of the fact that organization of living matter is more significant for the understanding of life than is the enumeration of the elements which are brought together in this organization, does not for a moment ignore the elements which constitute the living organism, but does call attention to the unique product of their organization. Similarly with conscious experience, it cannot be regarded as standing alone, explicable without reference to the sensory and motor processes, or without reference to the processes of nervous organization with which it appears to develop in the animal world. Experience is, however, a unique fact. When one has described the nervous organization of an animal, he must say that this organization is the condition of experience, but it is not identical with experience. Experience is, like life, related to organized physiological structures; it is, however, a body of processes constituting a world of reality which cannot be either overlooked or subordinated to the conditions of organization which make it possible. Indeed, experience has a type of reality which justifies the assertion that it is the primary reality. For the individual, the world of experience is so essentially the center of his unity and of his existence that all of his other attributes, such as physical organs, even though they are related to experience, are seen only indirectly through experience. Thus, when we wish to know the nervous conditions of our experience, we are obliged to study ourselves through experience and to arrive by a series of indirect observations and inferences at a full knowledge of all these conditions.

"The physiological conditions of experience do not lose reality because they can be studied only through experience itself, neither does experience lose its reality because its conditions are known. The difficulty in the whole situation is that the individual who is trying to explain and understand himself sometimes loses sight of the central fact of his own mental life, as he explores the conditions which surround this central personality. The central personality is taken so much for granted that scientific description tends to deal with all that leads up to personality, and there it stops, finding its chief subjects of thought in these surrounding facts, rather than in the central result of all the organized conditions. Some day the historian of thought will write it down as one of the curious fallacies of immature science that certain physiologists, biologists, and even psychologists, were satisfied to call their own personalities mere by-products, without essential significance in the world, just because they did not find consciousness capable of description in the regular scientific formulas adopted for the discussion and explanation of external reality. One hardly knows how to find phrases in which to answer those who hold consciousness to be less real and potent than physical forces. Certainly, nature has protected and conserved consciousness throughout the whole development of the animal kingdom. Certainly, the world is different because consciousness has been evolved. Certainly, consciousness is no less real than are its conditions; and, finally, consciousness is certainly much more directly approachable to the student of science than is matter."

[Judd, C. H., *Psychology* (Charles Scribner's Sons, New York, 1907), pp. 59–63. By permission.]

The remaining selections of this chapter are designed to throw as much light as possible on the nature of education when regarded from the point of view of the functional psychology.

5. MAN AS A BEHAVING ORGANISM *

"It is impossible to disguise the fact that in the psychology of our own day the emphasis is transferred from the mind's

* James, William, *Talks to Teachers*. By permission of Henry Holt and Company.

purely rational function, where Plato and Aristotle, and what one may call the whole classic tradition in philosophy had placed it, to the so long neglected practical side. The theory of evolution is mainly responsible for this. Man, we now have reason to believe, has been evolved from infra-human ancestors, in whom pure reason hardly existed, if at all, and whose mind, so far as it can have had any function, would appear to have been an organ for adapting their movements to the impressions received from the environment, so as to escape the better from destruction. Consciousness would thus seem in the first instance to be nothing but a sort of super-added biological perfection,—useless unless it prompted to useful conduct, and inexplicable apart from that consideration.

"Deep in our own nature the biological foundations of our consciousness persist, undisguised and undiminished. Our sensations are here to attract us or to deter us, our memories to warn or encourage us, our feelings to impel, and our thoughts to restrain our behavior, so that on the whole we may prosper and our days be long in the land. Whatever of transmundane metaphysical insight or of practically inapplicable aesthetic perception or ethical sentiment we may carry in our interiors might at this rate be regarded as only part of the incidental excess of function that necessarily accompanies the working of every complex machine. . . .

". . . [But] the inessential 'unpractical' activities are themselves far more connected with our behavior and our adaptation to the environment than at first sight might appear. No truth, however abstract, is ever perceived, that will not probably at some time influence our earthly action. You must remember that, when I talk of action here, I mean action in the widest sense. I mean speech, I mean writing, I mean yeses and noes, and tendencies 'from' things and tendencies 'toward' things and emotional determinations; and I mean them in the future as well as in the immediate present. As I talk here, and you listen, it might seem as if no action followed. You might call it a purely theoretic process, with no practical result. But it *must* have a practical result. It cannot take place at all and leave your conduct unaffected. If not to-day, then on some far future day, you will answer some question differently by reason of what you are thinking now. Some of you will be led by my

words into new veins of inquiry, into reading special books. These will develop your opinion, whether for or against. That opinion will in turn be expressed, will receive criticism from others in your environment, and will affect your standing in their eyes. We cannot escape our destiny, which is practical; and even our most theoretic faculties contribute to its working out.

". . . As teachers, I sincerely think it will be a sufficient conception for you to adopt of the youthful psychological phenomena handed over to your inspection if you consider them from the point of view of their relation to the future conduct of their possessor. Sufficient at any rate as a first conception and as a main conception. You should regard your professional task as if it consisted chiefly and essentially in *training the pupil to behavior;* taking behavior, not in the narrow sense of his manners, but in the very widest possible sense, as including every possible sort of fit reaction on the circumstances into which he may find himself brought by the vicissitudes of life.

"The reaction may, indeed, often be a negative reaction. *Not* to speak, *not* to move, is one of the most important of our duties, in certain practical emergencies. 'Thou shalt refrain, renounce, abstain!' This often requires a great effort of will power, and, physiologically considered, is just as positive a nerve function as is motor discharge."

Education and Behavior. . . . [We are thus] "led to frame a very simple conception of what an education means. In the last analysis it consists in the organizing of *resources* in the human being, of powers of conduct which shall fit him to his social and physical world. An 'uneducated' person is one who is nonplussed by all but the most habitual situations. On the contrary, one who is educated is able practically to extricate himself, by means of the examples with which his memory is stored and of the abstract conceptions which he has acquired, from circumstances in which he never was placed before."

Definition of Education. "Education, in short, cannot be better described than by calling it *the organization of acquired habits of conduct and tendencies to behavior.*"

It will be noted that the definition quoted above makes the goal of education center itself in what the learner does rather than in the information he obtains, except in so far as the information

leads to action. The child comes into the world with some rather definite modes of activity and tendencies to action which constitute his means of adaptation, for the time being, to the world in which he lives. But he responds to a very limited portion of his world at this period and these unlearned responses with which he is already equipped are merely those that are necessary to keep him alive. From this time forward he must *learn* to act in such a way as will adapt him to a more and more complex and varied environment. These original modes of action and tendencies to action will be modified to suit the existing conditions, and to the original stock of activities there will be added many tendencies to action coming as a result of increased maturity, but taking the form that the particular environment in which he is placed determines. The environment to which he must become adapted is a highly artificial one, in the sense that it has been created as a result of the living and learning of many past generations of human beings. The unique conditions that make possible these adaptations in the case of human beings are expounded by Bagley in the following paragraphs.

[James, W., *Talks to Teachers*. By permission of Henry Holt and Company, New York, (1913) pp. 23–24, 26–29.]

6. EDUCATION A NECESSITY *

"Fundamentally the possibility of education depends upon the capacity of the organism to profit by past experiences. In one way or another the facing of past situations comes to modify present and future adjustment. Education in its broadest sense means just this: acquiring experiences that will serve to modify inherited adjustments."

Man in Contrast to Lower Forms of Life. "In order to understand the fundamental significance of this principle, we must know that the capacity to profit by past experience is limited to a comparatively few forms of life. In the lower animals, reaction or adjustment is fixed and uniform. It varies only with the nature of the stimulus and not with the results of previous reactions to similar stimuli,—only with the nature of the en-

* Bagley, W. C., *The Educative Process*. By permission of The Macmillan Company.

vironment and not with the results of previous adjustments to similar environments. A certain situation 'sets off' a certain fixed, unvarying reaction. No matter if that reaction has resulted disastrously in previous instances, the same stimulus will again initiate it; there will be no improvement in adjustment even after repeated trials. The classic instance of the moth and the flame is a case in point. The light impressions 'set off' the muscular reactions that carry the moth to the flame. Its wings are scorched and it retreats,—adjustments resulting in the retreating movement having been set off by the effect of the scorching upon the nerve endings. But let the light again impinge upon the sense organs of sight, and the forward movement will again be initiated,—to be repeated, no matter how frequently the scorching may occur, until the stimulus is either withdrawn or replaced by another more compelling, or until the moth is disabled or consumed. . . .

"The moment that the moth emerges from its pupa stage it assumes all the functions of an adult member of its species. It does not have to be taught where and how to procure its food; it does not have to be taught where and how to secure shelter or protection against the elements; it does not have to be taught where and how to lay its eggs and provide for its young. If it does these things, it does them by instinct—by the innate tendencies of the nervous system to react to definite situations in a definite manner. Two essential points are to be noted in this connection: the moth can develop into a mature insect without the presence or aid of other insects; furthermore, it can develop into *just as good a moth* as either of its parents. Man, on the other hand, comes into the world immature; only a very few of the functions of complete development are present at birth. Certain functions, as, for example, *nutrition,* are operative from the first, and these are based entirely upon instinct. The infant possesses a nervous mechanism that will respond appropriately to certain stimuli immediately after birth. But the instincts that are operative in the infant are obviously much less efficient than those of the lower forms. Even possessing them the infant is a helpless and dependent creature.

"Nor is this all. Suppose that a method were devised by means of which food and shelter could be provided mechanically and the infant left to develop into independent maturity without the

aid of parents or other human beings. There is no need to make such an experiment, for the results would be obvious from the outset. The moth is 'born' just as good a moth as either of its parents. But the infant, even if he could reach maturity without the aid of other human beings, would certainly not be so good a man as his father. What he would lack are the great essentials of human life that are transmitted, not directly through the germ cell, but indirectly by social contact,—culture, 'education,' and civilized habits. Professor Baldwin has termed this factor *'social heredity'* in contradistinction to physical heredity or physical transmission. . . .

"It is clear, then, that man's supremacy in the animal series is due to his ability to profit, not only by his own *experiences,* but *also by the experiences of others.* Not only is this true, but it is also not to be doubted that, without this twofold capacity, man would be far below many other vertebrates and would be placed at a tremendous disadvantage in the struggle for existence. 'Every child is born destitute of things possessed in manhood which distinguish him from the lower animals. Of all industries he is artless; of all institutions he is lawless; of all languages he is speechless; of all philosophies he is opinionless; of all reasoning he is thoughtless; but arts, institutions, languages, opinions, and mentations he acquires as years go by from childhood to manhood. In all these respects the new-born babe is hardly the peer of the new-born beast; but, as the years pass, ever and ever he exhibits his superiority in all the great classes of activities until the distance by which he is separated from the brute is so great that his realm of existence is in another kingdom of nature.' . . .

"One further point remains to be considered in connection with the function of the school. As an agency of formal education, its field is largely limited to the period of individual immaturity,—the so-called 'period of infancy,' and to understand the function of the school one must grasp in some measure the significance of this period to human evolution.

The Meaning of Infancy. "The biological meaning of the helplessness and dependence of infancy has been fully recognized only in recent years. While some of the Greek philosophers hinted vaguely at its function, it is to John Fiske that the credit

must be given for endowing education with what is perhaps its most illuminating conception.

"(a) In the first place, *infancy is a period of necessary dependence.* The child lives what might well be termed an artificial life—a life where everything is provided for him, where he has to take no thought of food or shelter or clothing, where responsibility is borne by other shoulders. This means that the energy which would, under other conditions, be devoted to procuring food and clothing and providing shelter is available for other purposes.

"(b) In the second place, *infancy is a period of plasticity.* The lower animals are born with nerve connections already fixed and, except in the higher vertebrates, comparatively permanent and stable. In the nervous system of *man, the entire cerebrum is practically unorganized* at birth. It is a mass of latent possibilities, and whatsoever connections are made later are due almost entirely to the forces of the environment and not to the forces of heredity. But these connections, once made, also tend in the course of time to become permanent and somewhat inflexible. That is, after a certain plastic period the nervous tissue loses some measure of its plasticity. While it is still possible to learn new adjustments,—to acquire and profit by experiences,—after this time the task is much more difficult.

"The meaning of infancy is, therefore, economic leisure—freedom from the responsibilities of food-getting and self-support—and organic plasticity. Curiously enough, the Greek equivalent of the English word 'school'—*schole*—also means leisure. Because the child must be supported by the labor of others during this period, he can utilize his time and energy for remote rather than immediate ends; he can store up experiences for future years. Because his body, and especially his upper nerve centers, are in a plastic condition, the experiences that he acquires at this time can most easily make a deep and abiding impression. 'A comparatively witless infancy must augur the high intellectual development of the men and women of the race. What a vast difference between the amœba at the beginning of the animal scale and the human infant at the top! There parent and offspring are practically one, with no immaturity and no need of education. And between the two lie all varieties of animal life, with ever increasing complexity of struc-

ture and intelligence in the adult, and ever lengthening infancy and childhood in the offspring.'

Formal and Informal Education. "The school, then, is a specialized agency of formal education which aims to control in a measure the experiences of the child during the plastic period of infancy. It must be repeated, however, that education is not limited to the school. Wherever one individual learns from another how to better his life, how to meet more successfully the forces that oppose him, how to assimilate race-experience and profit by it—there an educative process is going on whether there be a school or not. And more than this: wherever one individual learns from his own experiences how to adapt himself more adequately to future situations, there an educative process is going on, whether there be a teacher or not. The education by the family up to the period of school instruction, the education by the family and by society during this period and afterward, the education of the individual in the 'school of experience'—none of these factors can be neglected. But while one recognizes this truth, one must also recognize that the school demands the largest share of attention and study, not because it influences the child *more* than any of the other forces,—home or society or life,—but because it is more amenable to control. It is through the school that the future of the race can be influenced with the greatest certainty. The factor of parental education is quite invariable; the same ends are sought and the same methods employed generation after generation. The social factor and that designated by 'life' are, on the contrary, ultra-variable, possessing so little stability that, notwithstanding their profound influence, their results can never be predicted with certainty. The school lies, therefore, between these two extremes as the one factor that is within our control in an appreciable degree."

[Bagley, W. C., *The Educative Process* (The Macmillan Company, New York, 1905), pp. 3–4, 8–10, 14–15, 29–33.]

QUESTIONS

1. State the position taken by Introspective, Functional, and Behavioristic psychology with reference to (a) the place of introspection, (b) the place of the nervous system, and (c) the place of behavior in the study of psychology.
2. Show what is implied in the phrase *psychophysical organism.*

3. What is meant by *the biological point of view* in psychology?
4. Outline Judd's argument that conscious processes are no less real and potent than physical processes.
5. Which, according to James, are the two functions of consciousness? Which does he regard as of greater importance for education and why?
6. How does James define *education?* Compare this definition with that of Bagley.
7. Explain in detail why man must be subjected to an educative process.
8. Discuss the phrase *the meaning of infancy.*

Read 1st and 3th chapters
Lundiford

CHAPTER II

BODY AND MIND

It is a remarkable fact that bodily defects which interfere greatly with the child's general development and success in school often remain undetected for a long time. Teachers should be sensitive to the need of being alert in the detection and correction of such defects as early as possible. The following report of a child whose apparent stupidity in school work was due to eye defect should emphasize the importance of this statement.

1. THE EFFECTS OF SENSORY DEFECTS ON SCHOOL WORK

"Wilbur displayed considerable bravado, strutting about the room at his full height and remarking cheerfully, 'I can read good.' A new brown suit anticipated his size some months hence and threatened to spill him out at any moment, for Wilbur was quite a little boy. Perhaps the newness gave him courage, for certainly rumor did not credit him with reading 'good.' He grasped the proffered book firmly in one stubby hand preparing to read from page thirteen of a certain primer. He began in the lower right-hand corner of the right-hand page, pointing out the lines from right to left with his left forefinger. The performance was like unto nothing we had witnessed before in the name of reading and without the pointing we might never have known where the start was made.

"He proceeded glibly—'Run, run, come and, away, run to the tree, come come, play, play and come today!' And then he stopped for the obvious reason that he could think of nothing more to say. We asked him to place his finger on a certain word. He shuffled around in the new suit, rocked the chair on two legs, closed the book very slowly, and smiled wanly. The game is up!

"He hadn't the slightest idea which word was 'play' nor

which was any other word we mentioned although he had been exposed to this beginning vocabulary for more than one semester. No formal test was needed to demonstrate his complete lack of reading vocabulary. His writing was equally weird. In Figure 1 some of his attempts are reproduced.

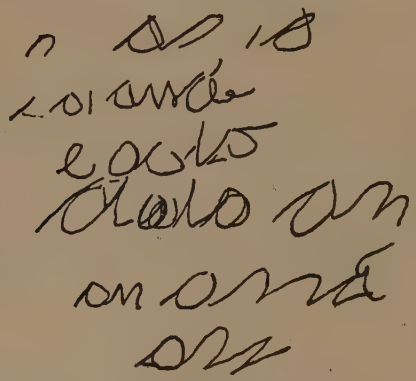

FIGURE 1

SAMPLES OF WILBUR'S WRITINGS

"Wilbur was an intelligent child, his score on the Detroit First-Grade Intelligence Test placing him in the middle group, Y, when he was six years old. He attended school regularly and gave no trouble. He was generally liked; his clean, well-cared for appearance, his ready smile, and big brown eyes made a quick appeal. But he was an utter failure at his school work, which was, of course, mainly reading. His mother could not explain his performances, and no facts in his history seemed pertinent to the situation. She was loath, however, to accept the father's verdict that he was 'stubborn and could read if he would,' and expressed her willingness to coöperate in any way.

"In attempting to solve the riddle of his unusual performance, Wilbur became an object of increasing interest. He was unstable and erratic about things in general, and, although his desire to learn was earnest and most evident, he trailed off into nothing with many tasks just as he did in reading that first day. Random associations mixed things up generally. He often seemed bent on doing something or other, just anything. Being

told that his name was to be written on the board, then asked what the word was, he replied, 'My sister's name is Ruth.' He persistently interpreted 'Run, Wilbur' by trying to stand on his head, probably because in trying to make him understand what the game was he had been told to do whatever the written command indicated even if it told him to stand on his head.

"He did not know what was meant by a letter, a word, or a sentence, and his attitude of extreme dependence was a great hindrance. He never did anything through to a finish without repeated efforts to get help when it did not seem necessary. His attention was very easily distracted and dangerously 'thin.'

"It is easy to discover that a child has no reading vocabulary, but quite another thing to determine why. It is easy to see that a child does not attend to a given object, but it is again quite another thing to determine the reason. This is of course an important matter, since attention is fundamental to learning. The difficulty may be congenital or it may be acquired. The two possibilities present entirely different situations to be met, it may be, in totally different ways.

"One day, Wilbur was presented with a chevron pattern in color cubes such as are commonly used in the kindergarten. He was expected to copy this pattern, which was coarse and not intricate, and the task was new and altogether attractive so he went about it most happily. The clue to all of Wilbur's difficulty appeared with sudden emphasis in this situation. He was unable to do the copying because, after a few minutes of application, his eyes began to stream water. The eye specialist, to whom he was taken at once by his mother, found him to be very farsighted and fitted him with glasses.

"Corrected vision, however, could not give him a reading vocabulary on the spot, and now he must reconcile a host of new images with a tangled mass of past experiences with words. The record shows that this was accomplished with about thirty minutes of instruction daily, the period of disturbed imagery covering about four months. There was nothing 'special' about the method used in teaching him, but the point that many readjustments must be made by a child in such a situation is a very important one. It takes time to do this. This fact should be recognized, and great patience shown during this period. No one can tell in how many guises any certain word may have

appeared to vision so badly focused, and confusion is to be expected.

"On March 8, about two months after the eye correction had been made, he was still apt to lose his place and to include in the sentence he was reading some rather distant portion of the page. In another month, however, losing the place was exceptional, and he had read sixty-five pages of the primer. In another two weeks, he had completed eighty-nine pages, his speed of recognition was noticeably greater, his expression good, and his pride in accomplishment was beautiful to look upon. Also he had learned to work acceptably with a group.

" 'I read seventeen pages last night,' he announced one morning, and without checking the accuracy of the statement we concluded that Wilbur was well started on the road to success in reading. He was promoted the following June and each semester thereafter, until now he has reached Grade V-B. Meanwhile, he has been transferred to another public school where his record in reading justifies our conclusions that poor vision was the cause of his difficulty."

[Leland, Bernice, *Journal of Ed. Research*, Vol. XVI (1927), pp. 132–135. By permission.]

2. FATIGUE IN SCHOOL WORK *

"*Importance to Teacher of Knowledge Concerning Fatigue.*—Much attention has been given in recent literature to the question of the nature of fatigue as well as to providing means of reducing it as much as possible in the pursuit of any occupation. For the teacher the study is supposed to be valuable first in determining when or if a student is working beyond his strength and secondly in seeking an arrangement of the school program which shall permit the accomplishment of the most work with the least fatigue. Obviously one might desire to know how to measure the effects of work upon the child in reference to his decreasing capacity for work, to be able to say if a particular child were working too hard and if possible to devise a daily regimen which would enable him to do the same work with less fatigue.

* Pillsbury, W. B., *Education as the Psychologist Sees It.* By permission of The Macmillan Company.

"*Definition and Detection of Fatigue.*—The general problem of mental fatigue must serve as a beginning in the discussion. An accurate definition offers some difficulties, for fatigue is not a state that can be seen for itself, nor do we have any consciousness that regularly accompanies it. Possibly it may be provisionally defined as a diminution in the capacity for any function that comes as a result of an exercise of that function. This definition suffers under one possible limitation from the fact that fatigue need not necessarily show in the actual output, because, after use, increased incentive may serve to keep the individual working harder and so lead him to keep up the output at the expense of greater effort. We might well say that the function was fatigued although no evidence of it appears in the result. The only effect is to be seen in the fact that the point at which work must stop is brought measurably nearer by the previous work or in the feeling of greater effort or other bodily sensations which accompany the work.

"*Is Fatigue Real?*—We should need to modify our definition to say that fatigue is the decrease in ability to accomplish the same amount with equal effort, or possibly by the statement that fatigue is progress of the individual towards the point where a given function will cease to be available. The idea that lies back of the notion of fatigue is that there is a limited capacity for work in each respect and that any exercise of a function serves to draw upon that sum total of energy until it is exhausted. This picture of the nature of human energy has been contested. In fact, present opinion as to fatigue seems to be divided into two camps. One insists that there is no such thing as fatigue; the other that you can be fatigued without knowing it. Thorndike, who represents the negative side, argued from some experiments a few years ago that there was no mental fatigue, that one might become bored and not work so hard, but could always work as fast and well, provided only one cared to. Dodge, also on the basis of careful experimental work, argued on the contrary, that one was always becoming fatigued whenever work of any kind was being done, but that the effects were usually concealed under the greater effort that was brought out by fatigue. One might exaggerate the two theories by saying that one insists that you never tire mentally, the other that you were always in the process of tiring but did not always know it. . . .

"*Physical Changes in Mental Fatigue.*—When we ask about the nature of mental fatigue from the standpoint of the organic changes we have only indirect evidence. Of course all mental work has an effect upon the muscles indirectly, but probably it is seldom if ever sufficient in the intensity or extent of the movement to create real conditions of fatigue in the sense of either accumulation of poisons or exhaustion of the stored nourishment of the muscle. Most of the physical effects must be ascribed to the changes in the neurones of the nerve centers involved. Whether there is real exhaustion here has been questioned by Lee, who, working with Thorndike, came to the conclusion that there was no fatigue of the nerve centers, no use of the substances of the neurone that would not be compensated for by the nutritive substances drawn from the blood as the tissue of the cell body was oxidized. A negative conclusion of this kind cannot of course be final in the present state of our methods of experimenting upon the central nervous system. We must look for indirect evidence.

"*Changes in Metabolism During Mental Work.*—As to the effects of mental work upon the bodily metabolism as a whole, results differ greatly. Atwood with his calorimeter could detect no increase in the heat output of the body during mental work over that when the individual was resting as completely as possible, while he found very marked effects to accompany muscular work; Dodge on the other hand tested the effects of hard mental work upon the circulation and found that it had the same effect as lifting a heavy weight. The Atwood method was probably more direct, but the work was of relatively short duration and the experiment was not frequently repeated. We might argue that even the ordinary thought processes always and unavoidably produce a certain effect in the bodily metabolism and that an attempt to do hard work does not markedly increase them. The Dodge method would have the advantage of measuring the effects of shorter periods of work. The circulatory effects may be noticed almost immediately, while changes in the output of heat would not be measurable except when the work extended over a considerable period of time.

"*Changes in Circulation in Fatigue.*—More specific effects of long continued work seem to indicate bodily changes. Mental

work has been shown by Griffitts and the writer to decrease the blood pressure when continued for two hours. Lewis found that there was an increase in the amount of adrenalin in the circulation as work was more prolonged. This would probably be an automatic protection against the effect of fatigue, since adrenalin serves to increase the tonic reaction of the organism. There may be changes in the cortical cells, there may be the same accumulation of fatigue products as from physical exertion. Pieron has obtained evidence that sleep may be due to the development of a toxin in the blood, and mental work has the same general tendency to produce sleep that physical work has. While not conclusively established, the evidence indicates that mental work has definite physical accompaniments that are at least similar to the results induced by physical work. . . .

"*Effects of Rest.*—If a rest period is introduced, such as a recess in school, and work begins again, there is usually a slight increase at first through the initial spurt, then again after that has been succeeded by the fall after the passing spurt, a slight rise due to inertia and practice appears. Whether the immediate effect is up or down depends upon the degree of fatigue and the duration of the intermission. If fatigue is great, the beneficial effects will be more pronounced than if the fatigue is less. Again if the intermission be too long, one may lose more from the decreased inertia than is gained by recovery from fatigue. The more difficult the work, the more frequent and the longer should be the intermissions. Young children cannot be expected to work long without breaks. Obviously more experiments are necessary before we can make definite statements about the length of the rest period that is best in each set of circumstances. For adults doing mental arithmetic it was found that one five-minute interval in a two-hour work period gave the most satisfactory result. The general principles stated above may be effective as a general guide for practical trials. Friedrichs working with school children found a much smaller number of mistakes if an eight-minute recess was introduced between two class periods of an hour each than if one followed directly upon the other. When there were three hours of work, a rest of fifteen minutes between each hour gave a marked decrease in mistakes in dictation as compared with no rest and also as compared with only one

rest period. If only one rest period were to be introduced, it was better to have it at the end of the first hour rather than after the second. . . .

"*Little Evidence of Fatigue in School Work.*—When we turn from the results of experiments and their theoretical discussion to the more practical application, it seems that for the normal individual working no harder than is required by the ordinary school work, the effects of fatigue are unimportant. The effects of incentives and inertia more than overcome the effects of fatigue during the usual school day. Gates found that if he measured the capacity of the child by his accomplishment in working arithmetical problems, marking out letters and in different types of memory tests, that there was a gradual increase in the amount of work for each hour of the school day after the first. The only exception was found in the first period after the noon recess, during which certain tests showed a loss and others little or no gain. Gates asserts that ordinary school work is not severe enough to produce any considerable fatigue. The only conclusion that he draws is that the first period in the afternoon should be used for the relatively easy subjects.

"*Young Children Fatigue More Quickly.*—Winch applied a slightly different test to the same end. He used as his measure of fatigue, not the accomplishment at different periods, but the relative increase in rate and accuracy of solving arithmetical problems during a series of tests. He applied the tests to children of different ages from the earliest at six to seven, to both boys and girls of thirteen or fourteen. His results agree with Gates' in showing that there is little or no demonstrable fatigue for the older children induced by the work of the school day. They improve, on the average, just as much in the work performed at 3 : 30 as at 9 : 00 in the morning. The younger children, on the contrary, show decidedly the effects of fatigue. There is during the last school hour a decrease, rather than an increase due to the practice effect. Winch concludes that training is absolutely useless for children of from six to seven years at 3 : 30 in the afternoon after a day in school. Fatigue is too strong to be overcome. Ten-year boys showed a slight effect of fatigue, boys of thirteen almost none at all.

"It would seem that for practical school purposes the amount of fatigue induced by the ordinary school work is almost neg-

ligible for the older children. It may be detected with the very youngest. Of course, too, it is possible that one might need to make exceptions in this statement in case of the feebler or more nervous children. They would form special cases and must be considered as such. More is made of it in Europe where, undoubtedly, the school discipline is more rigorous and more strenuous work is demanded of the students at all ages. Even here the adjustment of work to produce the minimum of fatigue may be desirable for the weaker individuals, or for exceptional cases.

"*Fatigue and Boredom.*—The relation between fatigue and lassitude or boredom has been much discussed. Thorndike, as was remarked, has insisted that boredom is the only real cause for diminution of work; while fatigue has no real existence. It is still too soon to decide definitely on this point. Certain it is that disinclination to work is frequently the first effect of work, particularly of monotonous work. Probably it is the most frequent occasion for the cessation or slowing up of work in the ordinary school. Even this should be avoided as far as is possible by making the work interesting and by changing from one type of work to another. It has been shown that physical work which is interesting is less fatiguing as measured even by the amount of work that can be done after a certain point has been reached than is monotonous work. Here the interest consisted merely in setting a goal to be reached in pressing a spring downward with the thumb. The uninteresting work consisted merely in pressing as far as possible without any definite goal. In mental work, also, one will work very much longer and with greater application when interested than when merely working against time. When writing a thesis that is interesting, or finishing a piece of constructive work, one will work far into the night with little apparent decrease in capacity. When the work is uninteresting, no matter how pressing the demand that it shall be done, fatigue or unwillingness to work begins early and one takes the first opportunity of an excuse from the need of eight hours' sleep or other hygienic rule to stop.

"School children, in the same way, will continue with work in the form of a game, for a much longer time than they will spend on the same amount of learning that is presented as a part of the regular routine work. Not all work can be made interesting and perhaps it is as well that the child should form habits of per-

forming tasks just because they must be done. In after life he will be unable to avoid work of this kind and he should be in a measure prepared for it by the work of the school. That should not be taken to mean that tasks should be made monotonous for the sake of discipline. There is always enough work that must be uninteresting in every curriculum to furnish all of the discipline needed. All that will be necessary is that the child be not excused from necessary tasks merely because he finds them uninteresting, after all possible has been done to give them an interesting form. This will develop the habit of doing essential work without asking if it is interesting.

"*Signs of Fatigue.*—Fatigue bears little necessary relation to the feelings of fatigue. These may be very much related to boredom. Mental fatigue is frequently accompanied by physical movements of different sorts. These give rise to sensations from the member and in the mass may give the impression of fatigue. The disinclination to work may be noticed directly. Neither sign is of very high predictive value. Many times when the individual feels a marked disinclination to work, he may be able to do work above the average if only he will make the effort. On the other hand, special excitement may make a man feel capable of good work when he has already worked more than he should. In this case he will likely be able to work well, although at the expense of a sleepless night afterwards and possibly a bad day following. One can only decide in terms of past experience as to the after effects of work under the conditions in question, whether the sensations and other signs indicate real fatigue or are fallacious. For adults the interpretation must be left to the individual. Usually, and possibly fortunately, decision is more likely to be made in terms of the established routine than by sensations. Even if one is not bound by rules of any type, one is pretty sure to form habits of work and to devote set times to work of each kind and to have other regular periods for recreation.

"*Fatigue a Safety Valve.*—The function of fatigue or boredom is to save the individual from too great exhaustion. It appears before the danger point is reached in practically every individual, in some much before, in others only as the point of exhaustion approaches. Whether we are to regard the sign as real fatigue or merely as boredom matters very little for practical purposes. Those who believe in the reality of fatigue admit that the signs so

far as they are represented in sensation are frequently ambiguous. They appear almost as often when the person is still capable of excellent work as when he has passed well beyond the maximum.

"The great difference in the two schools is that one believes that the individual never works to the point of exhaustion, that his fundamental capacity for work is never reduced by mental work and hence that feelings of fatigue are always fallacious. The other school, while admitting that signs are deceptive, in so far as one is capable of working with unreduced efficiency much after the sensations of fatigue become well marked, still believes that there is a reduction in the organic capacity as work goes on. There is evidence that the slight decrease in the work actually done, even over a comparatively long period, is due to the fact that, under incentives, there is an increased effort that compensates for the waning power. As in physical work, it is possible that the signs and effects of fatigue itself serve as a stimulus to effort, as the first effect of waste products upon the muscle is to increase its irritability. The sensations of fatigue spur to increased effort, just as distraction incites to greater attention.

"*Mental Exhaustion Possible.*—We have evidence that after mental work is continued long enough there comes a time when work is no longer possible. Painter reports that when, after a hard day, he tried to do mental arithmetic from 11 P. M to 3 A. M., he suddenly reached a point where he could do no more. Even when he changed to easier problems he could not succeed in any of them. Dodge reports similar experiences with eye-muscles. He could move his eyes up to a certain point with no indication of fatigue either from decreased rate or irregularity of movement, and then movement stopped suddenly. He could not move them at all. If this be true, we would have what we find, that the course of work shows relatively little decline as the task proceeds. There is a real decrease in amount of available energy, if we may use a loose term, but practice, inertia, and other facilitating processes overcome the effects at first, and then as these lose their effect, extra effort comes in to keep the output up almost to the normal. Very late, after the work has been continued far beyond the point where work usually stops, there comes a point of complete exhaustion. When this is reached no amount of effort is capable of producing more work. It comes suddenly and may end in sleep, or

possibly merely in incapacity. Certain it is that this occurs only at a stage beyond that usually reached in ordinary work.

"*Means of Recovery from Fatigue.*—A series of practical questions arises naturally in connection with the best means of recovering from fatigue. Two means are frequently suggested popularly: one is to change the nature of the work, the other to turn to physical exercise. So far as we have experimental evidence, neither is efficacious. Whether changing work does or does not result in reducing fatigue depends upon whether the work to which one changes is easier or more difficult. Change to work of the same difficulty has no effect; if the work be easier, fatigue is naturally less rapid. This holds of fatigue as such, based on the results of Kraepelin's students. There is or may be a noticeably increased interest in a change that reduces boredom and spurs to greater effort. This is temporary.

"*Physical and Mental Fatigue.*—The same holds of physical work. The capacity for physical work is decreased by mental fatigue and also the capacity for mental work decreases as a result of physical work. One is in no condition for hard study after a game of football or a vigorous day in the open. The introduction of physical work even for a short period does not assist recuperation. This does not mean that the permanent effects of physical work may not be beneficial. They are, in so far as exercise is essential to the development of the physical organism, which in turn is essential to the mental as well as bodily functions. If one is seeking the best means of resting from mental work, it is not found in physical work. It used to be thought that gymnastic work should be introduced when the student was fatigued. Experience showed, however, that the student did poorly in his gymnastic exercises when mentally fatigued, and also that he did not prepare for his later studying by the exercises. If one desires to recover from fatigue, the best method is to do nothing, so far as that is possible. Sleep is still more effective if there is time and opportunity for it.

"*Work and Ventilation.*—Closely related to fatigue in diminishing efficiency is the effect of bad air. Here again, the effects are slow to show themselves. One, according to experiments, can do as good work in a room too hot, too moist, or too dry as in a room that is at the optimum in each of these respects. The optimum conditions assume a temperature of 68, a humidity of 50 and 45

cubic feet of air per person. These results do not mean that ventilation may not be important, simply that under effort one adapts one's self to unfavorable conditions. Health, at least, demands good air, as is seen in the treatment that is given in tuberculosis and the improvement that weakly children show in open air rooms. As in fatigue, the normal individual automatically compensates for unfavorable conditions, within fairly wide limits."

[Pillsbury, W. B., *Education as the Psychologist Sees It* (The Macmillan Company, New York, 1925), pp. 263–265, 269–271, 273–274, 275–282.]

3. THE ENERGIES OF MEN

Second Wind. "Everyone knows what it is to start a piece of work, either intellectual or muscular, feeling stale—or cold, as an Adirondack guide once put it to me. And everybody knows what it is to 'warm up' to his job. The process of warming up gets particularly striking in the phenomenon known as 'second wind.' On usual occasions we make a practice of stopping an occupation as soon as we meet the first effective layer (so to call it) of fatigue. We have then walked, played, or worked 'enough,' so we desist. That amount of fatigue is an efficacious obstruction on this side of which our usual life is cast. But if an unusual necessity forces us to press onward, a surprising thing occurs. The fatigue gets worse up to a certain critical point, when gradually or suddenly it passes away, and we are fresher than before. We have evidently tapped a level of new energy, masked until then by the fatigue-obstacle usually obeyed. There may be layer after layer of this experience. A third and a fourth 'wind' may supervene. Mental activity shows the phenomenon as well as physical, and in exceptional cases we may find, beyond the very extremity of fatigue-distress, amounts of ease and power that we never dreamed ourselves to own,—sources of strength habitually not taxed at all, because habitually we never push through the obstruction, never pass those early critical points."

Reserve Mental Energy. "For many years I have mused on the phenomenon of second wind, trying to find a physiological theory. It is evident that our organism has stored-up reserves of energy that are ordinarily not called upon, but that may be called upon: deeper and deeper strata of combustible or explosible material, discontinuously arranged, but ready for use by any-

one who probes so deep, and repairing themselves by rest as well as do the superficial strata. Most of us continue living unnecessarily near our surface. Our energy-budget is like our nutritive budget. Physiologists say that a man is in 'nutritive equilibrium' when day after day he neither gains nor loses weight. But the odd thing is that this condition may obtain on astonishingly different amounts of food. Take a man in nutritive equilibrium, and systematically increase or lessen his rations. In the first case he will begin to gain weight, in the second case to lose it. The change will be greatest on the first day, less on the second, less still on the third; and so on, till he has gained all that he will gain, or lost all that he will lose, on that altered diet. He is now in nutritive equilibrium again, but with a new weight; and this neither lessens nor increases because his various combustion-processes have adjusted themselves to the changed dietary. He gets rid, in one way or another, of just as much N, C, H, etc., as he takes in per diem."

Efficiency Equilibrium. "Just so one can be in what I might call 'efficiency-equilibrium' (neither gaining nor losing power when once the equilibrium is reached) on astonishingly different quantities of work, no matter in what direction the work may be measured. It may be physical work, intellectual work, moral work, or spiritual work.

"Of course there are limits: the trees don't grow into the sky. But the plain fact remains that men the world over possess amounts of resource which only very exceptional individuals push to their extremes of use. But the very same individual, pushing his energies to their extreme, may in a vast number of cases keep the pace up day after day, and find no 'reaction' of a bad sort, so long as decent hygienic conditions are preserved. His more active rate of energizing does not wreck him; for the organism adapts itself, and as the rate of waste augments, augments correspondingly the rate of repair.

"I say the rate and not the time of repair. The busiest man needs no more hours of rest than the idler. Some years ago Professor Patrick, of the Iowa State University, kept three young men awake for four days and nights. When his observations on them were finished, the subjects were permitted to sleep themselves out. All awoke from this sleep completely refreshed but the one who took longest to restore himself from his long vigil only slept one-third more time than was regular with him.

"If my reader will put together these two conceptions, first, that few men live at their maximum of energy, and second, that anyone may be in vital equilibrium at very different rates of energizing, he will find, I think, that a very pretty practical problem of national economy, as well as of individual ethics, opens upon his view. In rough terms, we may say that a man who energizes below his normal maximum fails by just so much to profit by his chance at life; and that a nation filled with such men is inferior to a nation run at higher pressure. The problem is, then, how can men be trained up to their most useful pitch of energy? And how can nations make such training most accessible to all their sons and daughters. This, after all, is only the general problem of education, formulated in slightly different terms."

Qualitative Levels. " 'Rough' terms, I said just now, because the words 'energy' and 'maximum' may easily suggest only quantity to the reader's mind, whereas in measuring the human energies of which I speak, qualities as well as quantities have to be taken into account. Everyone feels that his total power rises when he passes to a higher qualitative level of life.

"Writing is higher than walking, thinking is higher than writing, deciding higher than thinking, deciding 'no' higher than deciding 'yes'—at least the man who passes from one of these activities to another will usually say that each later one involves a greater element of inner work than the earlier ones, even though the total heat given out or the foot-pounds expended by the organism, may be less. Just how to conceive this inner work physiologically is as yet impossible, but psychologically we all know what the word means. We need a particular spur or effort to start us upon inner work; it tires us to sustain it; and when long sustained, we know how easily we lapse. When I speak of 'energizing,' and its rates and levels and sources, I mean therefore our inner as well as our outer work."

[James, William, *Memories and Studies* (Longmans, Green & Co., New York, 1911), pp. 229–235.]

The enthusiasm with which James depicts the rewards of persistency should not blind us to the handicap which adverse bodily conditions often make in the production of effective mental work, nor to the dangers involved in excessive fatigue.

4. PHYSICAL CONDITION AND MENTAL CAPACITY

"Interest and zest for mental pursuits is sometimes maintained in spite of poor physical background, we know; such studies as those of Gulick and Ayres have shown this. Nevertheless, it is not true in all cases. We ourselves know instances where, with improved health, the reports on conduct and school standing, and also the industrial record, were greatly changed. We know, too, cases where findings on tests were altogether different after the child had been built up physically. Anemia, malnutrition, or debility following illness, is sometimes the explanation of mental dullness which might be confused with innate defect. In all such cases it seems only fair to give the individual the benefit of the doubt. He needs, in any case, all the physical help which can be given him, and unless the mental disability is so extreme as to preclude any possibility of poor physical conditions as an explanation, the final diagnosis should be held in abeyance. To be remembered always, particularly with young children, are the recently studied disturbances of function of the glands of internal secretion. Both we and many others have seen results nothing short of marvelous through treatment of these troubles in children who appeared exceedingly dull in some aspect of their mental life. This makes us all the more conscious of the contributions that future research may bring forth concerning relationships between physical and mental conditions.

"*Case 1.* By way of illustration of the effect of physical conditions on mental life, we cite the case of Edith N., who represents findings that are not at all uncommon in our experience. When twelve years old she was brought to the clinic by her mother. At that time she was in the fourth grade of the public school. We found her to be in very poor condition physically, suffering from anemia, defective vision, enlarged glands; there was a history of former otorrhea; the girl was dull and listless, and the results on psychological tests were very poor. According to Binet scale she ranged as $9\frac{2}{5}$ years mentally. She failed on our simpler Construction Test and did very little in the way of school work, failing to spell correctly anything but the easiest words, or to solve any number work but the very simplest. The case was referred to a clinic for physical treatment and later to a convalescent home.

"Thirteen months after this we had occasion to study this case once more. We found then that our advice had been acted upon, with the result that the girl had improved immensely. She had gained about twenty-six pounds in weight, had grown an inch; her vision was corrected by glasses, her throat was in good condition, tonsils and adenoids had been removed. Altogether she showed a wonderful improvement. The interesting feature from the point of view of our present discussion was the tremendous gain which we found on the mental side. She now passed up through the twelve-year Binet tests; solved correctly the Construction Test, which was previously a failure, as well as a more difficult one, which had not been tried before. A number of other tests corroborated these findings. We noted that she still was very poor in school work, but it must be remembered that during the intervening period she had practically no opportunity of attending school. Furthermore, she showed little interest in school; perhaps her discouragement was a natural state of affairs, since she was in a very low grade for a girl of her age. But it would be the height of folly to state that her school retardation was an evidence of innate mental defect, just as earlier it would have been altogether unfair not to have taken into account the effect of the poor physical conditions upon test results.

"We may note that there are three general aspects to the problem of the relation of physical disability to mental performance. First, poor physical conditions may not affect the quality of mental activities at all; second, psychological examination in the laboratory may not reveal the influence of poor physical status on mental achievement, particularly if the examination is brief and hence requires little prolonged attention and effort. But inability to cope with the requirements of school life may nevertheless be the direct result of the lack of physical vigor and health. Third, poor physical conditions may directly affect performance on tests as well as other mental effort.

"It can readily be understood that in reaching a diagnosis of mental capacities one must be careful not to confuse innate disability with special defect due to a defective sensory organ. I need but mention troubles with vision and hearing. It requires hardly a moment's reflection to be convinced of the vast amount of routine school work that is profitless to a child who either cannot see or cannot hear normally. It is quite generally recognized that

sensory defects frequently act as irritants, influencing a wider range of activity than those correlated with the actual sense organ itself. Eye strain coupled with visual defect leads to nervousness and irritability; the consequences of several types of ear troubles, such as variability of hearing that accompanies otorrhea, are equally important. Many a child is accounted stupid who is really dull from remediable sensory defects. Much as these subjects have been discussed, we find many instances where there has been utter neglect of such troubles. In spite of our present method of medical inspection in schools, there are, we know from experience, many cases of children who have unrecognized physical ailments which affect their school work to an extent that is altogether unappreciated.

"*Case 2.* Recently a nine-year-old boy was brought to us because, on the basis of supposed defect for school work, he was believed to be a suitable subject for the state institution for the feeble-minded. He had attended school for three years and was still in the first grade. He was indeed dull looking, and had one dared form an impression from his appearance and listless manner, one might have concluded that the boy was mentally defective. Physical examination showed him to be virtually blind in one eye with vision about two thirds of normal in the other. He was a sufferer from chronic otorrhea, and when examined in the clinic he was found to be partially deaf. Inquiry regarding the school career elicited the fact that the boy had never been examined by the school physician, and that no recognition had ever been made of the fact that he was suffering from sensory defects which required immediate attention. Psychological examination proved that the boy tested almost normal for his age.

"*Case 3.* For similar reasons we studied a boy where the neglect of visual defect was equally egregious. He, too, was considered by his teachers as unable to learn school subjects, but a careful mental examination by us showed the boy was rather in advance of his chronological age, and was suffering from excessive visual defect. Sent to a correctional institution, he had broken his glasses shortly after commitment, and during the nine months which intervened between that time and our examination, his eyes had never been retested nor had glasses been obtained for him, and yet, in this case, the main reason for commitment was to give the lad educational opportunities.

"So obvious is the distinction between special defect in the language field and poor results on tests due to speech defect, that we need but mention it. It is quite generally recognized that stuttering or stammering may retard normal progress as well as become a great factor in conduct problems. Of course, such defects can scarcely be overlooked in mental examination, and the only caution to be observed is a proper interpretation of the extent of the influence of both test results and school standing. Any diagnosis of mentality based solely on Binet or any 'measuring scale,' which consists largely of language tests, is altogether to be discountenanced in the study of individuals with speech defects."

[Bronner, A. F., *The Psychology of Special Abilities and Disabilities* (Little, Brown & Company, Boston, copyright 1917), pp. 24–29. By permission.]

QUESTIONS

1. If a child is failing to learn to read, what is the most obvious possible reason?
2. Does the mind have energy? Can any work be properly called mental work?
3. What is the distinction between fatigue and feelings of fatigue?
4. Describe the changes that usually take place as work proceeds.
5. What is the effect of rest periods?
6. How much fatigue is brought about by school work?
7. What is Thorndike's theory concerning decreased efficiency in mental work?
8. Discuss the means for recuperating from fatigue.
9. What is the relation between work and ventilation?
10. Summarize James's views on the energies of men.
11. Give illustrations of the effect of poor physical condition on mental ability.

CHAPTER III

ORIGINAL NATURE

1. ORIGINAL VERSUS LEARNED TENDENCIES

Relation of Original Nature and Environment. "Any man possesses at the very start of his life—that is, at the moment when the ovum and spermatozoön which are to produce him have united—numerous well-defined tendencies to future behavior. Between the situations which he will meet and the responses which he will make to them, pre-formed bonds exist. It is already determined by the constitution of these two germs, that under certain circumstances he will see and hear and feel and act in certain ways. His intellect and morals, as well as his bodily organs and movements, are in part the consequence of the nature of the embryo in the first moment of its life. What a man is and does throughout life is a result of whatever constitution he has at the start and of all the forces that act upon it before and after birth. I shall use the term 'original nature' for the former and 'environment' for the latter. His original nature is thus a name for the nature of the combined germ-cells from which he springs, and his environment is a name for the rest of the universe, so far as it may, directly or indirectly, influence him.

"In one sense nothing in human nature is due exclusively to either one of these factors. Those tendencies most dependent on the original nature of the organism require certain coöperation on the part of the environment; and those most dependent on outside circumstances still require some coöperation on the part of the organism. Even the first splitting of the fertilized ovum into two cells occurs only when adequate stimuli, for instance of temperature, act *ab extra;* and even the death of the organism by starvation occurs only, its date at least, in accord with certain responses from within.

"But in another sense the most fundamental question for human education asks precisely that we assign separate shares

in the causation of human behavior to man's original nature on the one hand and his environment or nurture on the other. In this sense we neglect, or take for granted, the coöperating action of one of the two divisions in order to think more successfully and conveniently of the action of the other. Thus, we say that man is by his original nature able to see, but that what he sees depends upon the environment he meets; or that original nature makes him respond to certain objects by fears, which environmental training weakens; or that a child instinctively conveys food to his mouth with the naked hand, but by habit comes to use a spoon as well; or that native curiosity develops, by proper training, into interests in the arts and sciences."

Original Nature an Abstraction. "The custom of thus abstracting out the original nature of man in independence of any and all influences upon it is so general and so useful that it is best to follow it throughout, remembering, however, that from the first moments after the fertilization of the ovum, a human individual is always an acquired nature,—that in the most original behavior discoverable, such as breathing or suckling, some outside conditions are involved,—and that in the most exclusively acquired or learned arts, such as knowledge of the square root of 256, some element of original capacity has a share.

"*The Problems of Original Nature.* Elementary psychology acquaints us with the fact that men are, apart from education, equipped with tendencies to feel and act in certain ways in certain circumstances—that the response to be made to a situation may be determined by man's inborn organization. It is, in fact, a general law that, other things being equal, the response to any situation will be that which is by original nature connected with that situation, or with some situation like it. Any neurone will, when stimulated, transmit the stimulus, other things being equal, to the neurone with which it is by inborn organization most closely connected. The basis of intellect and character is this fund of unlearned tendencies, this original arrangement of the neurones in the brain."

Original Nature as Related to Education. "The original connections may develop at various dates and may exist for only limited times; their waxing and waning may be sudden or gradual. They are the starting point for all education or other human control. The aim of education is to perpetuate some of them, to

eliminate some, and to modify or redirect others. They are perpetuated by providing the stimuli adequate to arouse them and give them exercise, and by associating satisfaction with their action. They are eliminated by withholding these stimuli so that they abort through disuse, or by associating discomfort with their action. They are redirected by substituting, in the situation-connection-response series, another response instead of the undesirable original one; or by attaching the response to another situation in connection with which it works less or no harm, or even positive good.

"It is a first principle of education to utilize any individual's original nature as a means to changing him for the better—to produce in him the information, habits, powers, interests and ideals which are desirable.

"The behavior of man in the family, in business, in the state, in religion and in every other affair of life is rooted in his unlearned, original equipment of instincts and capacities. All schemes of improving human life must take account of man's original nature, most of all when their aim is to reverse or counteract it."

[Thorndike, E. L., *The Original Nature of Man* (Teachers College, Columbia University, New York, 1913), pp. 1–4. By permission.]

Thorndike has made it clear in the above quotation that original nature and acquired nature are inextricably interwoven with one another. It is impossible to find in man any actions that are the result of original nature, in and of itself, and wholly separated from the effects of experience. Accordingly, there are some psychologists—notably some behaviorists—who hold that the concept *instinct* is totally misleading, and that it should not be used in a scientific psychology. The following quotation will serve to put this point of view before the student.

2. ARE THERE ANY INSTINCTS?

"Man is an animal born with certain definite types of structure. Having that kind of structure, he is forced to respond to stimuli at birth in certain ways (for example: breathing, heart-beat, sneezing, and the like). . . . This repertoire of responses is in general the same for each of us. Yet there exists a certain amount

of variation in each—the variation is probably merely proportional to the variation there is in structure (including in structure, of course, chemical constitution). It is the same repertoire now that it was when the genus homo first appeared many millions of years ago. Let us call this group of reactions, man's unlearned behavior."

Instincts Are in Reality Habits. "In this relatively simple list of human responses there is none corresponding to what is called an 'instinct' by present-day psychologists and biologists. There are then for us no instincts—we no longer need the term in psychology. Everything we have been in the habit of calling an 'instinct' to-day is a result largely of training—belonging to man's learned behavior.

"As a corollary from this, I wish to draw the conclusion that there is no such thing as an inheritance of capacity, talent, temperament, mental constitution and characteristics. These things again depend on training that goes on mainly in the cradle. The behaviorist would not say: 'He inherits his father's capacity or talent for being a fine swordsman.' He would say: 'This child certainly has his father's slender build of body, the same type of eyes. His build is wonderfully like his father's. He, too, has the build of a swordsman.' And he would go on to say: '—and his father is very fond of him. He put a tiny sword into his hand when he was a year of age, and in all their walks he talks sword play, attack and defense, the code of duelling and the like.' A certain type of structure, plus early training—slanting—accounts for adult performance. . . ."

James's List of Instincts Incorrect. "Up to the advent of the behaviorist, man was supposed to be a creature of many complicated instincts. A group of older writers, under the sway of the newly created theories of Darwin, vied with one another in finding new and perfect instincts in both man and animals. William James made a careful selection from among these asserted instincts and gave man the following list: Climbing, imitation, emulation and rivalry, pugnacity, anger, resentment, sympathy, hunting, fear, appropriation, acquisitiveness, kleptomania, constructiveness, play, curiosity, sociability, shyness, cleanliness, modesty, shame, love, jealousy, parental love. James claims that no other mammal, not even the monkey, can lay claim to so large a list.

"The behaviorist finds himself wholly unable to agree with James and the other psychologists who claim that man has unlearned activities of these complicated kinds. But you who are here to-night have been brought up on James or possibly even on a worse diet, and it will be hard to dislodge his teaching. You say, 'James says an instinct is "a tendency to act in such a way as to bring about certain ends without having foresight of those ends." Surely this formulation fits a lot of the early behavior of children and young animals.' You think you understand it, anyway. At first it looks convincing. But when you test it out in terms of your own observations on young animals and children, you find that you have not a scientific definition but a metaphysical assumption. You get lost in the sophistry of 'foresight' and 'end.'

"I don't blame you for being confused. No subject in psychology to-day is more written about than the so-called instincts. In the past three years more than a hundred articles have been written about instincts. The articles in general are of the armchair variety written by men who have never watched the whole life history of animals and the early childhood of the human young. Philosophy will never answer any questions about instincts. The questions asked are factual ones—to be answered only by genetic observation. Let me hasten to add that the behaviorist's knowledge of instinct also suffers from lack of observed facts, but you cannot accuse him of going beyond natural science in his inferences. Before attempting to answer the question 'What is an instinct?' let us take a little journey into mechanics. Possibly we may find that we do not need the term after all.

"*A Lesson from the Boomerang.* I have in my hand a hardwood stick. If I throw it forward and upward, it goes a certain distance and drops to the ground. I retrieve the stick, put it in hot water, bend it at a certain angle, throw it out again—it goes outward, revolving as it goes for a short distance, turns to the right and then drops down. Again I retrieve the stick, reshape it slightly and make its edges convex. I call it a boomerang. Again I throw it upward and outward. Again it goes forward revolving as it goes. Suddenly it turns, comes back and gracefully and kindly falls at my feet. It is still a stick, still made of the same material, but it has been shaped differently. Has the boomerang an instinct to return to the hand of the thrower? No? Well, why does it return? Because it is made in such a way that when it is thrown up-

ward and outward with a given force it must return (parallelogram of forces). Let me call attention to the fact here that all well made and well thrown boomerangs will return to or near to the thrower's feet, but no two will follow exactly the same forward pathway or the same return pathway, even if shot mechanically with the same application of force and at the same elevation; yet they are all called boomerangs. This example may be a little unusual to you. Let us again take one a little easier. Most of us have rolled dice now and again. Take a die, load it in a certain way, roll it, and the face bearing 'six' will always come up when the die is thrown. Why? The die must roll that way because of the way it was constructed. Again take a toy soldier. Mount it on a semi-circular loaded rubber base. No matter how you throw this soldier, he will always bob upright, oscillate a bit, then come to a steady vertical position. Has the rubber soldier an instinct to stand erect?

"Notice that not until the boomerang, the toy soldier and the die are hurled into space do they exhibit their peculiarities of motion. Change their form or their structure, or alter the material out of which they are made (make them of iron instead of wood or rubber) and their characteristic motion may markedly change. But man is made up of certain kinds of material—put together in certain ways. If he is hurled into action (as a result of stimulation), may he not exhibit movement (in advance of training) just as peculiar as (but no more mysterious than) that of the boomerang?

"*Concept of Instinct No Longer Needed in Psychology.* This brings us to our central thought to-night. If the boomerang has no instinct (aptitude, capacity, tendency, trait, etc.) to return to the hand of the thrower; if we need no mysterious way of accounting for the motion of the boomerang; if the laws of physics will account for its motions—cannot psychology see in this a much needed lesson in simplicity? Can it not dispense with instincts? Can we not say, man is built of certain materials put together in certain complex ways, and as a corollary of the way he is put together and of the material out of which he is made—he must act (until learning has reshaped him) as he does act.

"But you say: 'That gives your whole argument away—you admit he does a lot of things at birth which he is forced to do by his structure—this is just what I mean by instinct.' My

answer is that we must now go to the facts. We can no longer postpone a visit to the nursery. I think you will find there, in the two or three years we shall study the infant and child, little that will encourage you to keep sacred James' list of instincts. . . .

"*Summary of Unlearned Equipment.* Although our studies of man's birth equipment have only begun, we can get a fair picture of the type of activity to be seen and of the method of studying this equipment by what I have said to-night.

"At birth or soon thereafter we find nearly all of the so-called clinical neurological signs or reflexes established, such as the reaction of the pupil to light, the patellar reflex and many others.

"We find the birth cry followed forever afterward by breathing, the heartbeat and all circulatory phenomena, such as vasomotor constriction (decrease in diameter of vessels) and dilatation, pulse beat, etc. Beginning with the ailmentary tract we find sucking, tongue movements, and swallowing. We find hunger contractions, digestion, necessitating glandular reactions in the whole alimentary tract and elimination (defecation, urination, sweat). The acts of smiling, sneezing and hiccoughing belong in part at least to the alimentary canal system. We find also erection of the penis.

"We find general movements of the trunk, head and neck best observed, so far as the trunk is concerned, when the infant suspends himself with the hands. Rhythmical 'climbing' movements then appear. We can see the trunk at work in breathing, when the infant cries, during defecation and urination, when turning over or when the head is raised or turned.

"We find the arms, wrists, hands and fingers in almost ceaseless activity (the thumb rarely taking part until later). In this activity especially are to be noted: grasping, opening and closing hands repeatedly, 'slashing' about of the whole arm, putting hand or fingers into mouth, throwing arm and fingers to face when nose is held.

"We find the legs, ankles, foot and fingers in almost ceaseless movement except in sleep and even during sleep if external (and internal) stimuli are present. The knee can be bent, leg moved at hip, ankle turned, toes spread, etc. If the bottom of the foot is touched, there is a characteristic movement of the toes (Babinski

reflex); if the left knee is pinched, the right foot is brought up to the point of stimulation and vice versa.

"Other activities appear at a later stage—such as blinking, reaching, handling, handedness, crawling, standing, sitting up, walking, running, jumping. In the great majority of these later activities it is difficult to say how much of the act as a whole is due to training or conditioning. A considerable part is unquestionably due to the growth changes in structure, and the rest is due to training and conditioning.

"*What Has Become of Instincts?* Are we not ready to admit that the whole concept of instinct is thus academic and meaningless? Even from the earliest moment we find habit factors present—present even in many acts so apparently simple that we used to call them physiological reflexes. Now turn to James' list of instincts or turn to any other list of instincts. The infant is a graduate student in the subject of learned responses (he is multitudinously conditioned) by the time behavior such as James describes—imitation, rivalry, cleanliness and the other forms he lists—can be observed.

"Actual observation thus makes it impossible for us any longer to entertain the concept of instinct. We have seen that every act has a genetic history. Is not the only correct scientific procedure then to single out for study whatever act is in question and to watch and record its life history?"

[Watson, J. B., "What the Nursery Has to Say about Instincts," *Pedagogical Seminary and The Journal of Genetic Psychology*, Vol. XXXII, pp. 293–294; 303–306; 323–325.]

"Instinct" a Useful Conception. Almost all that Watson states in these quotations may be admitted without destroying the usefulness of the concept of "instincts." At birth and in very early childhood there are exhibited a number of activities that (1) are immediately adaptive to the conditions evoking them; that (2) persist throughout life with various degrees of modification; and that (3) occur in all, or practically all, individuals. In all three of these ways these activities are to be contrasted with *learned* activities (habits), and it is because of this contrast that it is believed that they are more largely due to heredity than are habits. But it must be admitted that these statements describe much more

definitely the activities known as reflexes than those called instincts. Activities generally regarded as instinctive are often much more likely to be modified during the course of experience, the stimuli which evoke them often seem much more varied, and there are more individual differences both in the time of their appearance and in their strength than in the case of reflexes. Any concrete instance of instinctive activity is, therefore, likely to be a compound of both instinct and habit. It is a habit-instinct or an instinct-habit. Nevertheless, there is a sufficient degree of impulsiveness, persistency, and universality about these activities to warrant us in the belief that they have a hereditary basis to a degree that is not true of more purely learned responses such as, for example, the habit of handwriting.

It must not be thought that reflexes and instincts represent the only factors in original nature. Besides the emotions which are closely related to instincts, there are "attitudes" of satisfaction and annoyance, emotional attitudes and "attitudes" of attention, all of which constitute a part of the inherited stock of responses. Furthermore, we should never lose sight of the fact that the capacity to learn—that is, modify original nature—is, itself, an original capacity.

3. ORIGINAL SATISFIERS AND ANNOYERS

Basis of Human Wants. "Reason finds the aim of human life the improvement and satisfaction of wants. By reducing those to which the nature of things and men denies satisfaction, or by increasing those which can be fulfilled without injuring the fate of others, man makes his wants better. By changing the environment into a nature more hospitable to the activities he craves, he satisfies them. The sciences and arts arose by the impetus of wants, and continue in their service. They are the ultimate source of all values.

"The original basis of the wants which so truly do and should rule the world is the original satisfyingness of some states of affairs and annoyingness of others. Out of such original satisfiers and annoyers grow all desires and aversions; and in such are found the first guides of learning.

"By a satisfying state of affairs is meant roughly one which the animal does nothing to avoid, often doing such things as attain and

preserve it. By an annoying state of affairs is meant roughly one which the animal avoids or changes."

Samples of Original Satisfiers and Annoyers. "Samples of original satisfiers or instinctive likes are:—To be with other human beings rather than alone, To be with familiar human beings rather than with strange ones, To move when refreshed, To rest when tired, To be 'not altogether unenclosed' when resting and at night.

"Samples of original annoyers or instinctive aversions are:—Bitter substances in the mouth, Being checked in locomotion by an obstacle, Being hungry, Being looked at with scorn by other men, The sight and smell of 'excrementitious and putrid things, blood, pus, entrails.'

"To satisfy is not the same as to give sensory pleasure and to annoy is not the same as to give pain. The latter confusion is specially misleading, for pain is only one of many annoyers, and does not inevitably annoy. Being gently held when one wants to fight, though not painful, is exceedingly annoying. A mother may welcome the pain she suffers for her child. With pleasure the case is somewhat different. If by it is meant simply the felt tolerability and welcomeness of a state of affairs, pleasure is a close symptom —almost a synonym—of satisfyingness. But the pleasurableness of certain sensations as commonly described in psychological treatises is a very partial symptom. Thus a sweet taste may be annoying and a bitter taste welcomed.

"A long list could be made of such states of affairs as feeding when hungry, rest when weary, being cuddled when sleepy, running after an animal that arouses hunting behavior, getting nearer to it in the course of the running, jumping upon it when near, seizing it after the jump, subduing it after seizing it, holding a baby after giving birth to one, having it smile when held, cooing to it when it smiles. Such a list, however, can be replaced by one law which any of its items would exemplify,—that when any original behavior-series is started and operates successfully, its activities are satisfying and the situations which they produce are satisfying. The absence of food when hungry, being held so that one cannot chase the passing rabbit, being out-distanced by it, clutching the air instead of the prey at which one leaps, having the offered toy withdrawn as one reaches for it, immovability in the obstacle one pushes, are samples from a similar long list of

original annoyers, all of the class described by the law that when any original behavior-series is started, any failure of it to operate successfully is annoying. . . .

"*The Importance of the Original Satisfiers and Annoyers.* It should be clear from facts already stated that the original tendencies of certain states of affairs to satisfy or to annoy are among the most potent determinants of human behavior and of those changes in it which result from education. Satisfaction and discomfort are in fact the great educative forces. They are such originally, and become still more so by virtue of the fact that behavior which is accompanied or closely followed by them becomes itself satisfying or annoying as the case may be. They are of very great value in the control of human nature because they are the roots of the phenomena which we call interests, desires, wants and motives.

"The original tendencies whereby this satisfies and that annoys are thus the ultimate selective forces in human behavior, providing the first rewards and punishments for education's use. From them, directly or indirectly, all later wants, interests and ideals derive their motive power. There is no other means of arousing zeal for a given course of thought or conduct than by connecting satisfaction with it; the mind does not do something for nothing."

Freeing One's Self from Prejudices. "The original satisfiers and annoyers show themselves emphatically to any competent observer who divests his attitude of the prejudices due to his individual make-up, to the elaborate reconstruction of his own satisfiers and annoyers by the circumstances of modern life and education, and to the abstract caricatures of man's wants which a too scholastic science has drawn. But such impartiality and sympathetic insight into fundamental human cravings are hard to attain. The quiet, peace-loving scholar is prone to regard the teasing and horse-play of youth as a profitless mania which a few words of advice should cure in all save the intellectually or morally perverse! The father, taught by school and shop to value only the products of activities, thinks he will satisfy his little son by nailing the boards, or filling the pail with sand, or sailing the boat, for him! The economist has counted on a man possessed by a single-hearted craving for food and shelter, and avoidance of pain and productive labor! Some moralists have discussed man as if he were a monomaniac seeking only sensory pleasures and

avoiding only sensory pains! Many metaphysicians have seemed to suppose that man's thinking was governed by a burning annoyance at contradictory judgments."

Putting Useful Attitudes to Work and Guarding against Dangerous Ones. "To free oneself from such prejudices and narrow inventories of man's original interests is the first step toward a reasonable use of them. The second is to put the useful ones to work and guard against the dangerous ones. Thus the very little child's satisfactions at bringing things to the mother and at carrying through a project to which original nature impels him are roots of coöperation and helpfulness and achievement. Thus, the satisfactions of sex indulgence or of absolute mastery over other human beings (as by position or wealth) are so potent and so disturbing to modern plans for man's welfare that chastity, equality and poverty should probably be the rule until the individual, by having been taught to find satisfaction in the welfare of others, the maintenance of an ideal self and the impersonal pleasures, has proved himself fit to use his body, position and wealth."

Attaching Satisfactions and Annoyances to Other Situations. "The third element in rational use of nature's capital of motives is to exercise ingenuity in attaching and detaching satisfaction and discomfort to and from this and that particular situation or feature of a situation. The genius at human engineering will learn to apply these forces with a skill like that whereby the mechanical and chemical engineers use the forces of gravity and atomic affinities. The triumphs so possible are of course not for me to illustrate, but I may note two obvious principles. First, the satisfyingness of a state of affairs is not an abstractly, uniformly potent thing, but depends on the total behavior-series in which the state of affairs happens. A boy may like to be petted by his mother, but not in public; he may like to work with tools when some special achievement has been suggested, but not when told, 'There are your tools; play with them.' The second fact is that the states of affairs which are constituted by the approval, scorn, kindliness and anger and the like of other human beings may fail of efficacy because of even slight departures from the typical original form of the behavior in question. Thus a parent or teacher who is reserved and constrained may, though sincerely approving, have the effect of indifference; on the other hand, a showy pretense at kindly interest is likely to be responded to as the meddling

which it really is. Children must not be expected to be mind-readers, nor on the other hand should any one hope that the ostensible meaning of words will substitute for the subtle characteristics of bodily attitude, facial expression, and quality of voice.''

[Thorndike, E. L., *The Original Nature of Man* (Teachers College), pp. 123–125, 295–297. By permission.]

4. DOES NATURE SUPPLY THE AIM OF EDUCATION? *

''Educational reformers disgusted with the conventionality and artificiality of the scholastic methods they find about them are prone to resort to nature as a standard. Nature is supposed to furnish the law and the end of development; ours it is to follow and conform to her ways. The positive value of this conception lies in the forcible way in which it calls attention to the wrongness of aims which do not have regard to the natural endowment of those educated. Its weakness is the ease with which natural in the sense of normal is confused with the physical. The constructive use of intelligence in foresight, and contriving, is then discounted; we are just to get out of the way and allow nature to do the work. Since no one has stated in the doctrine both its truth and falsity better than Rousseau, we shall turn to him.''

Rousseau's Doctrine of Natural Education. '' 'Education,' he says, 'we receive from three sources—Nature, men, and things. The spontaneous development of our organs and capacities constitutes the education of Nature. The use to which we are taught to put this development constitutes that education given us by Men. The acquirement of personal experience from surrounding objects constitutes that of things. Only when these three kinds of education are consonant and make for the same end, does a man tend towards his true goal. . . . If we are asked what is this end, the answer is that of Nature. For since the concurrence of the three kinds of education is necessary to their completeness, the kind which is entirely independent of our control must necessarily regulate us in determining the other two.' Then he defines Nature to mean the capacities and dispositions which are inborn, 'as they

* Dewey, J., *Democracy and Education.* By permission of The Macmillan Company.

exist prior to the modification due to constraining habits and the influence of the opinion of others.' "

Its Strength. "The wording of Rousseau will repay careful study. It contains as fundamental truths as have been uttered about education in conjunction with a curious twist. It would be impossible to say better what is said in the first sentences. The three factors of educative development are (a) the native structure of our bodily organs and their functional activities; (b) the uses to which the activities of these organs are put under the influence of other persons; (c) their direct interaction with the environment. This statement certainly covers the ground. His other two propositions are equally sound; namely, (a) that only when the three factors of education are consonant and coöperative does adequate development of the individual occur, and (b) that the native activities of the organs, being original, are basic in conceiving consonance."

Its Weakness. "But it requires but little reading between the lines, supplemented by other statements of Rousseau, to perceive that instead of regarding these three things as factors which must work together to some extent in order that any one of them may proceed educatively, he regards them as separate and independent operations. Especially does he believe that there is an independent and, as he says, 'spontaneous' development of the native organs and faculties. He thinks that this development can go on irrespective of the use to which they are put. And it is to this separate development that education coming from social contact is to be subordinated. Now there is an immense difference between a use of native activities in accord with those activities themselves —as distinct from forcing them and perverting them—and supposing that they have a normal development apart from any use, which development furnishes the standard and norm of all learning by use. To recur to our previous illustration, the process of acquiring language is a practically perfect model of proper educative growth. The start is from native activities of the vocal apparatus, organs of hearing, etc. But it is absurd to suppose that these have an independent growth of their own, which left to itself would evolve a perfect speech. Taken literally, Rousseau's principle would mean that adults should accept and repeat the babblings and noises of children not merely as the beginnings of the development of articulate speech—which they are—but as

furnishing language itself—the standard for all teaching of language.

"The point may be summarized by saying that Rousseau was right, introducing a much-needed reform into education, in holding that the structure and activities of the organs furnish the conditions of all teaching of the use of the organs; but profoundly wrong in intimating that they supply not only the conditions but also the ends of their development. As matter of fact, the native activities develop, in contrast with random and capricious exercise, through the uses to which they are put. And the office of the social medium is, as we have seen, to direct growth through putting powers to the best possible use. The instinctive activities may be called, metaphorically, spontaneous, in the sense that the organs give a strong bias for a certain sort of operation,—a bias so strong that we cannot go contrary to it, though by trying to go contrary we may pervert, stunt, and corrupt them. But the notion of a spontaneous normal development of these activities is pure mythology. The natural, or native, powers furnish the initiating and limiting forces in all education; they do not furnish its ends or aims. There is no learning except from a beginning in unlearned powers, but learning is not a matter of the spontaneous overflow of the unlearned powers. Rousseau's contrary opinion is doubtless due to the fact that he identified God with Nature; to him the original powers are wholly good, coming directly from a wise and good creator. To paraphrase the old saying about the country and the town, God made the original human organs and faculties, man makes the uses to which they are put. Consequently the development of the former furnishes the standard to which the latter must be subordinated. When men attempt to determine the uses to which the original activities shall be put, they interfere with a divine plan. This interference by social arrangements with Nature, God's work, is the primary source of corruption in individuals. Rousseau's passionate assertion of the intrinsic goodness of all natural tendencies was a reaction against the prevalent notion of the total depravity of innate human nature, and has had a powerful influence in modifying the attitude towards children's interests. But it is hardly necessary to say that primitive impulses are of themselves neither good nor evil, but become one or the other according to the objects for which they are employed. That neglect, suppression, and premature forcing of some instincts at

the expense of others, are responsible for many avoidable ills, there can be no doubt. But the moral is not to leave them alone to follow their own 'spontaneous development,' but to provide an environment which shall organize them.''

[Dewey, J., *Democracy and Education* (The Macmillan Company, New York, 1926), pp. 131–134. By permission.]

QUESTIONS

1. Explain what Thorndike means by "abstraction" of the original nature of man.
2. Show in what ways education aims to treat original nature.
3. What are Watson's arguments in favor of giving up the concept of instincts?
4. Why is "instinct" a useful concept?
5. Give some examples of original satisfiers and annoyers.
6. Describe three ways in which original satisfiers and annoyers may be utilized in education.
7. What were Rousseau's views as to the relation between education and nature?
8. In what way was Rousseau right? in what way wrong?

CHAPTER IV

MENTAL MEASUREMENTS

The measurement of mental abilities and achievements has quite generally been regarded as one of the means by which the school accomplishes its purposes. It is only in recent years, however, that an approach has been made to precision of measurement in these fields. The first excerpt of this chapter shows the nature of measurement in general, and the way in which measurement may be applied to human capacities and achievements.

1. MEASURING RESULTS IN EDUCATION *

"*The Nature of Measurements.* Measurements in any field are essentially more exact definitions and descriptions of the amounts of various qualities possessed by objects in that field. Exactness in the definition and identification of an amount of a characteristic is made possible by comparing the amount in question to the amount contained in some well-known object. If the principal of a school, discussing the character of a certain boy, tells the teachers that this boy 'is almost exactly as deceitful as Harry Jones,' whose degree of deceitfulness is known to all the group, the principal may be said to have reported a rough measurement of the boy's character in respect to deceitfulness. Such a report may be called a 'measurement,' because it is relatively more exact and objective than the statement that the boy 'is a very deceitful youth.' The use of the well-known Harry Jones as a measure of the amount of deceitfulness supplies the necessary objective unit.

"If the individual used as a measure of amount is sufficiently well known to all concerned, measurements reported in terms

* From Trabue's *Measuring Results in Education,* by arrangement with American Book Company, New York, (1924), pp. 17–30.

of that individual as a unit may be quite useful. William Jackson may, for example, be reported as having just a little more of deceitfulness in his nature than has Harry Jones. Such a statement is approximately as accurate and useful as the statement would be that John Smith is about six times as tall as the length of the king's foot. If the individual with whom comparisons are made is not well known or easily available for reference, comparisons or measurements in terms of that unit are, of course, practically useless.

"Where all those concerned in the measurement are well acquainted with several individuals possessing the trait to be measured, but each possessing it in different amount, these well-known individuals may be used as rough steps on a scale for the trait in question. If Mary has greater ability as a student than Jane, while Jane has greater ability than Susan, and Alice has less than Susan, these four girls may be used as a rough Scale for Ability-as-a-Student, by any group of teachers that knows

SCALE FOR ABILITY-AS-A-STUDENT

(Little Ability)	.....ALICE.....	SUSAN.....	JANE.....	MARY.....	(Great Ability)

them well. A new student might then be reported as having 'ability about equal to Jane' with some assurance that the other teachers would understand that the new student had less ability than Mary but greater ability than Susan and Alice.

"The distinguishing characteristics of measurement are its relative exactness and objectivity. A measurement is a description of an amount of some quality in terms of an objective unit of that quality which is relatively well known. Unless the amount of the characteristic contained in the reference unit is fairly objective,—that is, unless the amount may be observed and studied by any one interested in it—the report will not be clearly understood and will not be exact enough to deserve the name of measurement. The more objective the units in the scale, the more exactly may camparisons be made with the scale, and the more deserving will the results be of the term measurements.

"*The Advantages of Measurements.* The relative objectivity and exactness, which distinguish measurement from the ordinary

description of characteristics, are probably the two greatest advantages of measurements. The growth and development of every science has followed rather than preceded the establishment of measured observations. Astronomy did not develop until methods had been devised for recording objectively the locations of the stars at definite hours on definite dates. Biology was not recognized as a science until objective records began to be made of measured facts observed by nature lovers. Medicine became a science after definite records were kept of just how much of a given remedy was applied and exactly what happened in each case. Similarly, education will not be recognized as a science until it is possible to measure many characteristics of a pupil before and after a given type of instruction, and to determine thereby what is the effect of a particular treatment.

"Measurement in terms of an objective scale makes it possible to convey to other people in a very short statement a relatively clear conception of the amount of a quality present in a given object. Without some objective scale by which to identify this amount of the quality in question, it is necessary to describe at great length the amount discovered; and when the description is finished the hearer may not have obtained a clear idea of how strong the characteristic actually is. The most gifted writers of descriptive articles are usually the ones who draw the best analogies and make the most discriminating comparisons between the object observed and the common experiences of their readers,—the writers who come nearest to measuring the qualities of their objects by scales known to their readers.

"The effects of an observer's personal feelings and habits of thought tend to be greatly reduced by measurements. Many of us have had the experience of revisiting during adult life places we had not seen since early childhood, and have been shocked by the apparent shrinking up of distances and buildings that had previously seemed large. If we had measured these buildings and distances in our early experiences and also in our later visits, we should not have found any actual changes of the sort that seemed to have occurred. The average Frenchman would be called 'tall' by the Japanese, but would probably be considered somewhat 'short' by the Norwegians, although his actual height would be the same regardless of who measured it. The elimination of errors due to personal experi-

ences and standards, or at least their reduction to the smallest possible amounts, is one of the most important advantages of measurement over description.

"Measurement has also a decided advantage in that it makes possible a comparison of objects which cannot be brought into immediate juxtaposition. As long as the scale remains the same, objects which are thousands of miles from each other may be compared with reasonable accuracy. Growing objects may be compared at different periods of their growth merely by consulting the records of their measurements. The abilities of school pupils at the present time may be measured and compared with measurements of the same abilities in pupils a hundred years from now. Comparison by means of recorded measurements rather than by actual proximity is an invaluable aid in education, where we are primarily concerned with the changes that occur in individuals."

[Trabue, M. R., *Measuring Results in Education* (by arrangement with American Book Company, New York, 1924), pp. 17–30.]

2. MEASUREMENT IN EDUCATION

"The task of education is to make changes in human beings. We teachers and learners will spend our time this year to make ourselves and others different, thinking and feeling and acting in new and better ways. These classrooms, laboratories, and libraries are tools to help us change human nature for the better in respect to knowledge and taste and power.

"For mastery in this task, we need definite and exact knowledge of what changes are made and what ought to be made. In proportion as it becomes definite and exact, this knowledge of educational products and educational purposes must become quantitative, taking the form of measurements. Education is one form of human engineering and will profit by measurements of human nature and achievement as mechanical and electrical engineering have profited by using the foot-pound, calorie, volt, and ampere."

Recency of Measurement Movement in Education. "Until very recently, measurements of human qualities in education were rare. For example, the educational measurements reported by the federal and state and municipal governments up to 1910

concerned chiefly time and money, the number of teachers and students engaged, the number of days they spent, the value of buildings and grounds, the cost of books and supplies. The abilities of those who were educated and the betterments of intellect, character, and skill which were produced in them were left to speculation and faith."

Uncertainty of Students' Marks. "We had, of course, alleged measures of educational achievement in the 'marks' or 'grades' reported for each student in each study or activity, in promotions and graduations and honors, and in the results of examinations for licenses to practice law and medicine, or to teach, and for various posts in the civil service. These marks and grades, however, were opinions rather than measurements, and were subject to two notable defects. Nobody could be sure what was measured, or how closely the measure tallied with the reality! Marks in freshman algebra, for example, might be measures of inborn talent for mathematics, or of acquired power at mathematics, or of mathematical erudition, or of temporary memory, or of docility and fidelity in doing what the instructor desired! When we measured length or weight or volume or temperature or electric potential, all competent persons measured the same thing. But when we measured achievement in first-year Latin or college algebra, even the most competent twenty teachers measured twenty different composites.

"Dearborn found, for example, among instructors teaching the same subject in the same college to the same grade of students, some who gave ten times as many 'A's' as others did, and reported less than one-tenth as many failures. Finkelstein found that identical students in the same course taught during the first semester by one instructor and during the second by another, had three times the probability of a mark above 85 in the one case that they had in the other.

"The general result was scandalous. Foster found in the elementary courses at Harvard that 'A's' were thirty-five times as common in Greek as in English. Meyer found that over a period of five years one professor had never permitted a single student out of nearly a thousand to fail, whereas another in the same college reported nearly three hundred per thousand as failures.

"Moreover, even when we did know fairly well what we were measuring, the mark or grade given by any one examiner might

correspond only by a shockingly wide margin with the reality. For example, let the ability to be measured in geometry be defined as the ability to answer a certain specified set of questions and prove certain specified propositions. Elliott and Starch found that a hundred experienced teachers of mathematics assigned grades ranging from 28 to over 90 to the same set of replies in an actual examination paper.

"It may be thought that such variations as this 28 to 90 are largely due to a general severity or leniency in the judge, in which case deans, scholarship committees, and even students, might allow for them by multiplying each instructor's marks by some quantity representing his personal equation. The more important factors in causing such variations are, however, variations in the importance assigned to different qualities and a sheer inability to judge educational products accurately. Allowance for personal severity or leniency fails to eliminate the variation or greatly to reduce it.

"When a student received 70 as the official rating of his work for a year in English composition or Elementary Chemistry, or the History of England, neither he nor we knew what it was 70 of, nor whether it was really 60, 65, 70, 75, or 80 of it. Clearly defined units of measure and instruments by which to count them were lacking.

"The first steps to establish such units of educational products, and to devise instruments to measure them with reasonable precision were taken about a dozen years ago. The work began naturally enough with the simple matters of reading, writing, spelling, and arithmetic, which are a large fraction of the task of fifteen million children in this country each year.

"The hypotheses and experiments involved in establishing such educational units and scales are somewhat intricate and elaborate, and are too technical for presentation here, but the nature of the scales themselves may be at least roughly illustrated."

How to Measure Penmanship. "In penmanship, for example, imagine a row of specimens of handwriting beginning with one called zero because it is just not legible and possesses just not any beauty or other merit in handwriting. At the other end of the row is a specimen called 17 which possesses a very large amount of general merit as handwriting. In between are speci-

mens representing 1, 2, 3, 4, 5, and so on, each step of difference in merit being equal to any other. The unit is one-tenth of the difference between the best and worst writing found in 1,000 children of grades 5 to 8.

"When a desired or obtained change in ability to write is defined as improvement from 8 to 10 in this scale, anybody, anywhere at any time, can know what is meant almost or quite as definitely as when we speak of a baby changing from 8 to 10 pounds in weight, or a current increasing from 8 to 10 amperes. Impartial judges, rating a pupil's handwriting by pushing it along the scale until the point is found which it most resembles, will agree closely—not, of course, as closely as they would in measuring a wire with a foot-rule, but, with the aid of repeated measurements of it, closely enough for any important educational purpose involved."

Testing for Word Knowledge. "Or consider a measurement of word knowledge like this. The student sees a word followed by five other words or phrases. He is to underline that one of the five whose meaning is the same, or most nearly the same as that of the given word. The test begins with words in the first thousand for importance, such as:

afraid	full of fear	possible	necessary	raid	ill
baby	manner	trembling	little child	notice	soft

It continues with words of less and less importance, but all in the first ten thousand for importance, having, for example, to represent the tenth thousand, such words as:

ambiguous	offensive	uncertain	roomy	very large	material
canyon	menagerie	palate	valley	gun	rule
classify	arrange	pacify	make clear	recede	promote
divulge	different	common	tell	repress	project

Such an instrument for the measurement of word knowledge has many merits. For our present purpose we may note two obvious ones: the score is absolutely objective—the same test paper would receive the same rating from any examiner; the examinations for different classes or in different years can be made exactly equal in difficulty.

"While scientific workers in education have been establishing

units and scales of educational achievement, the psychologists have been improving their tests of intelligence. The two sciences are also coöperating in devising tests of various scholarly capacities, such as the capacity to learn arithmetic, the capacity to learn to spell, or the capacity to learn Latin.

"Measurements of pupils' capacities and achievements in more or less standardized psychological and educational units, are now a common feature of elementary schools. At least a million boys and girls, probably, were measured last year in respect to general intellectual capacity for school work. The number of such measures of reading, writing, spelling, arithmetic, history, and geography made during the year, probably exceeded two millions. . . .

"On the whole, it appears that the effort to replace opinion by measurement in our ratings of the achievement of higher education will increase and spread rapidly. Indeed, it may soon need protection from over-extravagant hopes more than from hostile criticism.

"In the elementary schools we now have many inadequate and even fantastic procedures parading behind the banner of educational science. Alleged measurements are reported and used which measure the fact in question about as well as the noise of the thunder measures the voltage of the lightning. To nobody are such more detestable than to the scientific worker with educational measurements."

Replies to Objections against Measuring in Education. "There are three criticisms in particular which even sound and accurate measurement in university education must meet:

"First, it will be said that learning should be for learning's sake, that too much attention is given already in this country to marks, prizes, degrees, and the like, that students work too much for marks rather than for real achievement. Whatever force this argument has, is towards abandoning our official measures of achievement or towards making them measures of real achievement. Students will work for marks and degrees if we have them. We can have none, or we can have such as are worth working for. Either alternative is reasonable, but the second seems preferable.

"Second, it will be said that the energy of teachers should be devoted to making achievements great rather than to measur-

ing how great they are. It is true that for many teachers and many students, it is wise to teach and learn as well as may be, leaving the results to faith and hope, or even charity. Moreover, there are gifted personalities to whom scientific and business-like procedures are alien and even odious, and who should not be required to measure what they are doing or even, in the ordinary sense of the word, to know what they are doing. Their genius is better than efficiency. There are, however, not enough of these to be more than a negligible factor in, say, the teaching of freshman English or first-year anatomy or the Law of Contracts. Most of us need to know what we are trying to teach or learn, and how far we have taught it or learned it; most of us will be aided, not hindered, by instruments for measuring educational purposes and products.

"Third, it will be said that only the baser parts of education can be counted and weighed, that the finer consequences for the spirit of man will be lost in proportion as we try to measure them, and that the university will become a scholarship factory, turning out lawyers and doctors guaranteed to give satisfaction, but devoid of culture. This is a part of the general fear that science and measurement, if applied to human affairs—the family, the state, education, and religion—will deface the beauty of life, and corrode its nobility into a sordid materialism. I have no time to present evidence, but I beg you to believe that the fear is groundless, based on a radically false psychology. Whatever exists, exists in some amount. To measure it, is simply to know its varying amounts. Man sees no less beauty in flowers now than before the day of quantitative botany. It does not reduce courage or endurance to measure them and trace their relations to the autonomic system, the flow of adrenal glands, and the production of sugar in the blood. If any virtue is worth seeking, we shall seek it more eagerly the more we know and measure it. It does not dignify man to make a mystery of him. Of science and measurement in education as elsewhere, we may safely accept the direct and practical benefits with no risk to idealism."

[Thorndike, E. L., in *Twenty-first Year Book,* National Society for the Study of Education (Public School Publishing Company, Bloomington, Illinois, 1922), pp. 1–4, 8–9.]

3. SOME EDUCATIONAL OUTCOMES YET TO BE MEASURED

The Broader Outcomes of Education. "Before discussing measurement, an important distinction must be made. There are two ways of considering what comes out of any particular educative experience, each proper for its purpose. One is more usual than the other, but the unusual one gives the basis for the most of what is here presented. One way—the usual one—is to think of the educational experience in terms of its single dominant learning outcome as conceived by the teacher or experimenter in charge, and to ask accordingly how much spelling is being learned or what progress is being made in long division or what increase in speed of tapping is attained. For the study of any one specific function this is not only proper but generally essential. The other way is much broader. It considers the changes all told that come to the learner from the experience. He may make progress in spelling, but he may possibly increase at the same time an already nascent dislike for the subject or for the school or for the teacher. A moment's reflection will show that while any one, child or adult, is engaged in any enterprise, he is not only responding 'focally' to the elements in the situation having to do with prosecuting the enterprise narrowly considered, but if the enterprise be sufficiently extended, he responds in addition 'marginally' in many attendant ways. He feels exultation as success attends. He grits his teeth when failure threatens, and he is determined to succeed. He likes and approves the conduct of his fellow-workers, or contrariwise he disapproves and dislikes. He finds his confidence in himself along this line growing or waning. He is 'making up his mind' whether to undertake anything else like this. In the end his enterprise succeeds or fails, and he responds accordingly to the various factors, particularly to the persons and programs, that entered into the determination of success or failure. The single experience under consideration may not go far toward building abiding attitudes, but the aggregate of such experiences up to any moment of life will (working on original nature) build the aggregate of one's attitudes to that moment, and out of the attitudes so built will come life's de-

cisions at that time. In this influence on life we face, then, a most important consideration.

"The broader point of view cannot be disregarded. While the experimenter may select one single learning outcome for his specific consideration, still if he is experimenting with human beings, there are limits within which he must remain. The courts, for example, will not allow him to disregard entirely what else in the way of learning is taking place. Corruption of youthful morals would not be allowed even though the experimenter showed to the court that in other ways results valuable to psychology were being achieved. What every normal person would thus recognize as controlling in such an extreme case is, in greater or less degree, obligatory on every teacher of children all the time. Each teacher must consider all that is being learned. The attitudes built during any one course may prove to be more significant for the child's future than the specific learning tasks assigned and accomplished for that course. Even for one period some attendant outcome may be tragic in its consequences. The teacher in order to discharge this duty must be sensitive to what is being learned, considered in the aggregate, in its totality. The teacher's duty is to face and meet this total educational situation."

Measurement Movement Must Face the Necessity of Measuring Total Effects. "If measurement, then, is to help the teacher at all points of his task and duty, measurement also must recognize these two kinds of outcomes, must face and grapple with this aggregate educational output. That the difficulties in the way of solving the problem so raised are great need not be questioned. In their entirety they may possibly be insuperably great. But three things it seems fair to demand of measurement and of its promoters: first, that they admit the existence of this problem and rate fairly its importance; secondly, that they seriously attack it wherever a promising opening can be found; thirdly, that at least they teach measurement and its applications in such fashion as to help and not hurt the education of our children considered in this only true light, the aggregate output."

[Kilpatrick, W. H., From *Contributions to Education,* Volume I, pp. 86–88. Copyright 1924 by World Book Company, Yonkers-on-Hudson, New York. By permission.]

Amongst the methods of treating the results of measurement most frequently used in educational psychology is that of computing the coefficients of correlation between various data; it is, therefore, essential that the student should have a general understanding of the meaning of this term—at least to the degree that it is described in the following treatment of the subject.

4. CORRELATION

"Do the pupils who read most rapidly comprehend best what they read? Are those who do the formal arithmetical processes skillfully the ones who reason best? Are those who know the most facts in geography the ones who 'generalize' best about the problem situations in geography? Are the most 'intelligent,' the best spellers? These are rather important pedagogical questions. There are many others like them. We used to dispose of them rather arbitrarily and quite without evidence. We had certain preconceptions about reading ability, for example. Reading to be well done had to be slowly and carefully done. Is it true, though? If we measure pupils' rates of reading and also their comprehension of what they read, what do we find? Do the slowest readers comprehend best what they read? Not all. Some do and some do not. The diagram below is one way of showing this. It shows the names of pupils in exact rank order in both rate and comprehension. Each line connects the two rank positions of the same pupil—his rank in the group in rate of reading with his rank in ability to comprehend."

Correlation Illustrated. "If rate of reading were perfectly related (or 'co-related,' or 'correlated,' as we shall call it) to comprehension, then each of the connecting lines would be exactly horizontal. Each pupil would occupy exactly the same rank position in rate and in comprehension. The first in rate would be the first in comprehension; the second in rate would be the second in comprehension; and so on to the last in rate, who would also be the last in comprehension. This would be called 'perfect correlation.' If it obtained, the two traits, 'ability to read rapidly' and 'ability to comprehend what is read' would be equally developed in people.

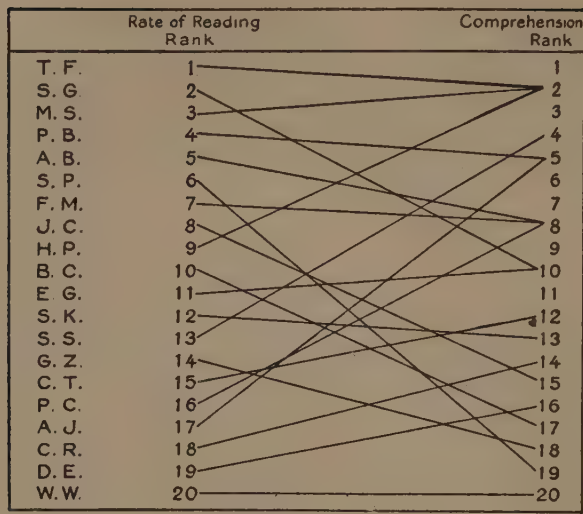

FIGURE 2

COMPARISON OF RELATIVE POSITIONS OF PUPILS IN RATE OF READING AND IN COMPREHENSION

"But the diagram shows that the two traits are not perfectly correlated. In fact no two human abilities are perfectly correlated. The lines tend to be somewhat horizontal. The pupils fall into about the same general division on each scale, but do not occupy exactly the same ranks.

"We can tell from the diagram only in a general way how closely the two traits are correlated. There are other ways to tell more exactly.

"One way is shown by the table on opposite page. The pupils are grouped in five groups with respect to their ability to comprehend. The average reading rates are then given for each group. The best four pupils read, on the average, nearly three times as fast as the poorest four, 252 against 92. And there is a steady increase from the poorest to the best readers, 92, 132, 169, 208, and 252. Such evidence tells us that there is a distinct tendency for those who read rapidly to comprehend best what they read. Vice versa, the slowest readers comprehend the least. And the relation appears to hold well throughout the group.

TABLE ILLUSTRATING HOW ABILITY TO COMPREHEND IS RELATED TO RATE OF READING [1]

How the pupils were grouped	*Scores in comprehension made by the pupils*	*Rate (words per minute) at which different groups read*
The four best in comprehension in the class	98	252
The next four best	86.5	208
The middle four	91.5	169
Four who were inferior in comprehension	91	132
The four poorest in comprehension	82	92

[1] These pupils were carefully tested by the Courtis and by the Burgess Reading Tests. Their ability to comprehend was marked rather accurately and their rates very accurately.

"But this method of telling to what extent things are related is not very exact. It leads only to statements about 'tendencies,' to 'in general it is true,' to 'there appears to be a correlation,' etc. We need more exact methods, so we use single numbers.

"*The Coefficient of Correlation, 'r'.* In a perfect correlation each pupil occupies the same position on each scale. We say that the correlation is 100, or better yet 1.0. It is the 'highest' we could get. It is inconceivable that two things could be more 'highly' or 'perfectly' correlated. We call this number the coefficient of correlation. The symbol for it is '*r*.' You would read *r* . . . 49, as 'the coefficient of correlation is .49.'

"Now suppose the most rapid reader was the poorest reader, the second most rapid reader was the next to poorest in comprehension, the third most rapid in rate was the third poorest in comprehension, and so on throughout the entire group. Then we would have 'negative' or 'inverse' correlation, where the high in one trait are the low in the other. Actually, we know that human traits are not so inversely, or negatively related.

"Now this is the most extreme case of 'negative' correlation we could have. The first are last and the last are first. We use

the number —1.0 to express this extreme negative correlation just as +1.0 is used for perfect positive correlation. Thus we can think of the correlation (relationship) between the two things as expressed by a single number. And we know now that that number will always be between +1.0 and —1.0. Think of the amount of correlation, the coefficients of correlation, as laid out along a scale, like the diagram."

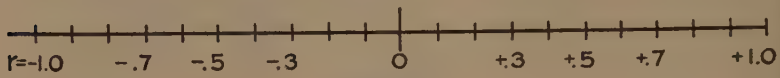

FIGURE 3

TO ILLUSTRATE HOW '*r*' MAY VARY FROM —1 TO +1

High and Low Coefficients of Correlation. "Now, clearly, *r* can vary all the way from +1.0 to 0 and from 0 to —1.0. It can be +.7, or +.02, or +.12 or 0, or —.07, or —.29, or —.82, etc. Is '$r = .70$' an example of 'high' correlation or does *r* have to be .80 or .90 to be 'high'? some educationists have been very careless in their interpretations of values of *r*. Some have called $r = .25$, 'distinctly marked correlation' and .40 'high correlation.' Others interpret 'high' to be anything above .60 and any value of *r* below .20 as 'very low.'

"By 'high' correlation is commonly meant a value of *r* which is about .5 to .7. By 'very high' correlation an *r* which is in the neighborhood of .8 and .9. By 'marked' correlation an *r* ranging from .35 to say .50. By 'low' correlation an *r* about .20 to .35. When *r* gets as low as .10, it is safe to conclude that there is no significant degree of relationship."

[Rugg, H. O., in *Twenty-first Year Book*, National Society for the Study of Education (Public School Publishing Company, Bloomington, Illinois, 1922), pp. 65–68. By permission.]

The theory that marks should be distributed in accordance with the normal probability curve is presented so that the student may get the arguments usually urged for such treatment of marks. Are these arguments sound?

5. HOW SHOULD MARKS BE DISTRIBUTED TO GROUPS OF PUPILS?

"If a five-step scale is used, what percentages of pupils should in the long run receive each of the five marks? To this ques-

tion the answer that I advocate is that the marks of large numbers of unselected pupils should be distributed approximately in conformity with the normal distribution or probability curve. Three lines of evidence for this position may be presented, the last two of which are fundamentally based upon the first:" *

Distribution of Mental and Physical Traits. "First, mental and physical traits, when measured in large numbers of individuals, are distributed in a manner which yields a distribution surface very nearly identical with that of the probability curve. . . . It seems reasonable to infer that abilities in school subjects are very probably distributed in the same manner as other mental traits."

Distribution of Abilities in School Subjects. "In the second place, when abilities in school subjects are measured by objective methods, they are found to be distributed in very close conformity to the probability curve. . . .

"Thus, for example, the scores of 662 seventh-grade pupils in the author's geography test show the following distribution when the total range of the base line is divided into five equal sections:

Scores	0–27	28–54	55–81	82–108	109–135
% of pupils	6	24	37	24	9

"This is a remarkably close conformity to the theoretical distribution proposed on the following pages.

"In the third place, the distribution of marks assigned by many teachers to large numbers of students conforms fairly closely to the normal distribution curve. When the marks of many teachers are combined, the idiosyncrasies of individual teachers tend to be counterbalanced. The figures below show the distributions of marks in various institutions and the extent to which they differ from the theoretical probability curve."

Percentages of Pupils Receiving Each Grade. "If we grant that marks in the long run should be assigned according to the normal distribution curve, what percentage of pupils should receive each of the five steps of the marking scale? If the base line of the probability curve . . . is divided into five equal

* Starch, D., *Educational Psychology.* Revised edition. By permission of The Macmillan Company.

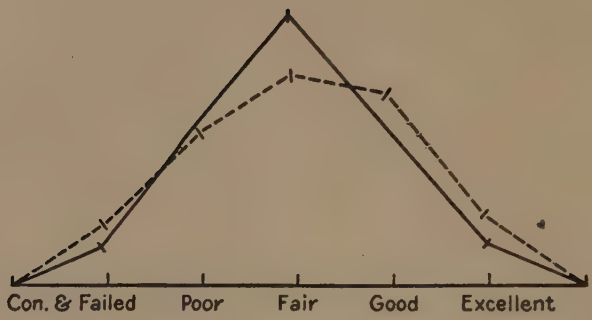

FIGURE 4

DISTRIBUTION OF 42,557 GRADES, BROKEN LINE, IN ELEMENTARY COURSES IN THE COLLEGE OF LETTERS AND SCIENCE OF THE UNIVERSITY OF WISCONSIN.

The continuous line is the theoretical distribution. After a report by President E. A. Birge.

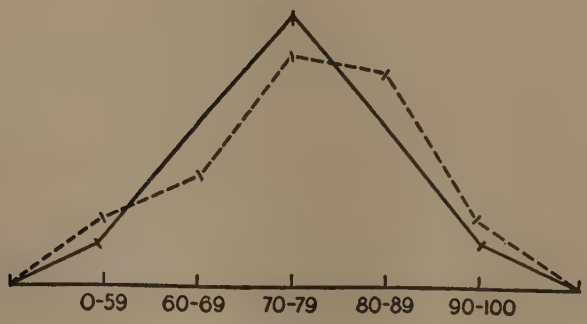

FIGURE 5

DISTRIBUTION OF 20,348 GRADES AT CORNELL UNIVERSITY.
After Finkelstein.

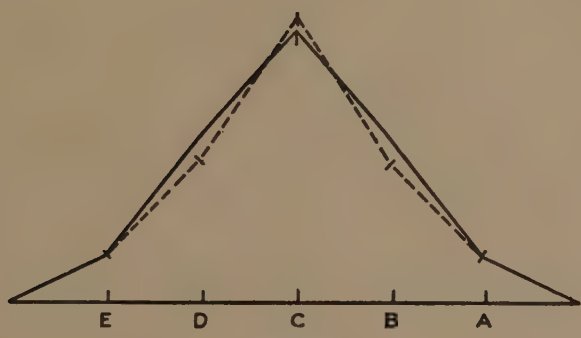

FIGURE 6

DISTRIBUTION OF 8,969 GRADES IN ELEMENTARY COURSES AT HARVARD UNIVERSITY.
After Foster.

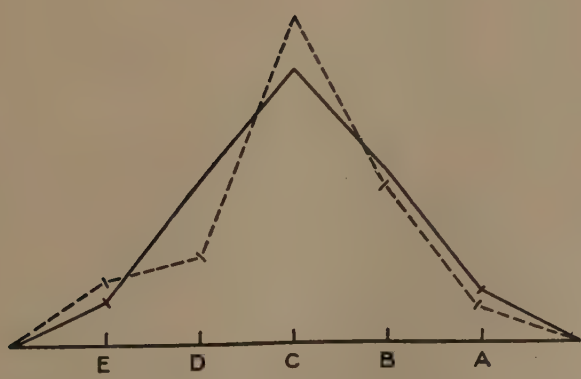

FIGURE 7

DISTRIBUTION OF 24,979 GRADES AT THE UNIVERSITY OF MISSOURI.
After Meyer.

divisions, then the area above the various divisions would comprise the following percentages of the total area:

A, Excellent,	or 93–100	— 7%
B, Good,	or 85– 92	— 24%
C, Fair	or 77– 84	— 38%
D, Poor,	or 70– 76	— 24%
E, Failure,	or 69	— 7%

"The figures above indicate how closely distributions of the marks at Wisconsin, Cornell, Harvard, and Missouri run parallel to the theoretical curve. The only difference is a slight skewing to the right. Not quite as many D's are assigned and very slightly more E's and A's are assigned than the theoretical distribution would demand. Thus the marks as actually assigned by hundreds of teachers to thousands of students furnish impressive support for the theory of the probability distribution of grades."

Objections Considered. "Certain objections, however, both of a theoretical and a practical kind, must be considered. In the first place, the soundness of the theory rests on the supposition that the pupils are unselected, chance specimens of mankind as a whole. This supposition, of course, never obtains absolutely for any group of human beings brought together anywhere. The very reason that brings any group together at the same time selects them. Pupils in school are not random samplings of human beings of their respective ages—the less so as one goes up the educational ladder. The tendency is that every rung of the ladder selects on the whole slightly better and better specimens. The fact, however, seems to be that the selection which does take place is not of the sort that materially modifies the form of the distribution curve but rather tends to contract its base. The selection that does take place is not an abrupt cutting off, but a gradual slicing off along a large share of the distribution surface. . . .

"The second objection urged by teachers against the adoption of the theoretical distribution of grades here recommended is that it would be unfair to lay down a rule that 7% of the pupils should be failed. How do we know? Possibly by good teaching all pupils may reach a sufficiently high attainment to be passed in the course. The answer to this statement is that the

effect even of the best teaching will rarely raise the attainments of pupils sufficiently high so that none of the pupils will fall below the passing grade; and furthermore, in the interests of reasonably high standards of scholarship the attainments of approximately 7% of large numbers of pupils will very probably not merit a passing grade. There should be doubly good reasons for passing all students or for failing considerably less than 7%. Many of the cases of 'good teaching' or 'unusual classes' prove to be spurious when it is possible to check them up by outside means.

"A third point is not so much an objection as a question of practical use of the principle of the distribution of grades; namely, in how large classes or groups of pupils should we expect fairly close conformity, and how close conformity should be expected? The answer to the question which I shall give, on the basis of experience in attempting to observe the principle in the assignment of grades, is that for groups of students of 100 or more quite close conformity should be expected. By quite close conformity I mean a deviation of not more than about 25% above or below the number of grades that theoretically should fall on a given step of the five-division scale. For example, the theoretical distribution demands that 7% of the pupils should receive the grade of A or Excellent. For groups of 100 or more pupils, this percentage should ordinarily not be lower than 5 nor higher than 9; the percentage of B's should ordinarily not run lower than 18 nor higher than 30; the percentage of C's should not run higher than 48, nor lower than 28, etc. The larger the number of pupils concerned, the closer the conformity should be. For groups smaller than 100 a wider latitude should be permissible whenever there is genuine reason for wider deviation. I advocate conformity to the theoretical distribution within the limits of common sense with as much deviation as may seem permissible for good cause. However, really genuine reasons for large deviations, even with classes as small as 25 pupils, unless obviously selected by special cause, are much rarer than teachers ordinarily believe."

"The theory of the probability distribution of marks should be observed with sense and reason and not in a purely mechanical manner. A blind, unintelligent observance of the principle is bound to lead to injustice, particularly with small classes. In

one such case which came to the author's attention it led to the giving of a mediocre grade to a pupil of very high ability.

"A fourth point frequently raised by teachers to justify unusually high or low marks is that the particular class in question is an unusually good one or poor one. Such a claim ought to be allowed only if it can be justified by good evidence. There are, of course, differences in classes, but these are almost never as great as we are inclined to believe. Large differences between successive classes in the same subject are for the most part illusory for the reason that the judgment of an individual teacher is more likely to deviate from a correct estimate than the average ability of a group deviates from the average of other groups. The teacher who says to each succeeding class that this is the best class he has ever had in this subject would possess, if this judgment were correct, a magic power for elevating the intellectual level of human beings.

"The feeling on the part of teachers that a given class is an unusually good or poor class is quite often due to one or two unusually good or poor individuals whose impression upon the mind of the teacher is outstanding, rather than to a higher or lower level of the class as a whole."

[Starch, D., *Educational Psychology*, Revised edition (The Macmillan Company, New York, 1927), pp. 526–534. By permission.]

QUESTIONS

1. Why is the measurement of mental abilities more difficult than the measurement of physical objects?
2. Explain what is meant by a standard measure. Name some standard measures of mental abilities.
3. What are the advantages of quantitative descriptions over merely qualitative description?
4. Describe the nature of a penmanship scale.
5. What criticisms are urged against mental measurements, and how may these criticisms be answered?
6. What types of educational changes are most likely to be disregarded in a testing program?
7. Give the meaning of the term *coefficient of correlation*, in such a way that a person who has not heard of its meaning could understand it.
8. Give arguments for and against the use of a normal curve in distributing school marks.

CHAPTER V

INDIVIDUAL DIFFERENCES

Among the most interesting and striking differences to be found in the mental equipment of individuals are the differences in mental imagery. Galton's study was one of the earliest and best of those that have been made of this subject.

1. INDIVIDUAL DIFFERENCES IN MENTAL IMAGERY

"Anecdotes find their way into print, from time to time, of persons whose visual memory is so clear and sharp as to present mental pictures that may be scrutinised with nearly as much ease and prolonged attention as if they were real objects. I became interested in the subject and made a rather extensive inquiry into the mode of visual presentation in different persons, so far as could be gathered from their respective statements. It seemed to me that the results might illustrate the essential differences between the mental operations of different men, that they might give some clue to the origin of visions, and that the course of the inquiry might reveal some previously unnoticed facts. It has done all this more or less, and I will explain the results in the present and in the three following chapters."

Galton's Questionnaire. "It is not necessary to trouble the reader with my earlier tentative steps to find out what I desired to learn. After the inquiry had been fairly started it took the form of submitting a certain number of printed questions to a large number of persons. . . . There is hardly any more difficult task than that of framing questions which are not likely to be misunderstood, which admit of easy reply, and which cover the ground of inquiry. I did my best in these respects, without forgetting the most important part of all—namely, to tempt my correspondents to write freely in fuller explanation of their replies, and on cognate topics as well. These separate

letters have proved more instructive and interesting by far than the replies to the set questions.

"The first group of the rather long series of queries related to the illumination, definition, and colouring of the mental image, and were framed thus:—

" 'Before addressing yourself to any of the Questions on the opposite page, think of some definite object—suppose it is your breakfast-table as you sat down to it this morning—and consider carefully the picture that rises before your mind's eye.

" '1. Illumination.—Is the image dim or fairly clear? Is its brightness comparable to that of the actual scene?

" '2. Definition.—Are all the objects pretty well defined at the same time, or is the place of sharpest definition at any one moment more contracted than it is in a real scene?

" '3. Colouring.—Are the colours of the china, of the toast, bread-crust, mustard, meat, parsley, or whatever may have been on the table, quite distinct and natural?' "

His Early Results. "The earliest results of my inquiry amazed me. I had begun by questioning friends in the scientific world, as they were the most likely class of men to give accurate answers concerning this faculty of visualising, to which novelists and poets continually allude, which has left an abiding mark on the vocabularies of every language, and upon which dreams and the well-known hallucinations of sick people are built.

"To my astonishment, I found that the great majority of the men of science to whom I first applied protested that mental imagery was unknown to them, and they looked on me as fanciful and fantastic in supposing that the words 'mental imagery' really expressed what I believed everybody supposed them to mean. They had no more notion of its true nature than a colour-blind man, who has not discerned his defect, has of the nature of colour. They had a mental deficiency of which they were unaware, and naturally enough supposed that those who affirmed they possessed it were romancing. To illustrate their mental attitude it will be sufficient to quote a few lines from the letter of one of my correspondents, who writes:—

" 'These questions presuppose assent to some sort of a proposition regarding the "mind's eye," and the "images" which it sees. . . . This points to some initial fallacy. . . . It is only by a figure of speech that I can describe my recollection of a

scene as a "mental image" which I can "see" with my "mind's eye." . . . I do not see it . . . any more than a man sees the thousand lines of Sophocles which under due pressure he is ready to repeat. The memory possesses it,' etc.

"Much the same result followed inquiries made for me by a friend among members of the French Institute.

"On the other hand, when I spoke to persons whom I met in general society, I found an entirely different disposition to prevail. Many men and a yet larger number of women, and many boys and girls, declared that they habitually saw mental imagery, and that it was perfectly distinct to them and full of colour. The more I pressed and cross-questioned them, professing myself to be incredulous, the more obvious was the truth of their first assertions. They described their imagery in minute detail, and they spoke in a tone of surprise at my apparent hesitation in accepting what they said. I felt that I myself should have spoken exactly as they did if I had been describing a scene that lay before my eyes, in broad daylight, to a blind man who persisted in doubting the reality of vision. Reassured by this happier experience, I recommenced to inquire among scientific men, and soon found scattered instances of what I sought, though in by no means the same abundance as elsewhere. I then circulated my questions more generally among my friends and through their hands, and obtained the replies that are the main subject of this and the three next chapters. They were from persons of both sexes, and of various ages, and in the end from occasional correspondents in nearly every civilised country. . . .

"It may seem surprising that one out of every sixteen persons who are accustomed to use accurate expressions should speak of their mental imagery as perfectly clear and bright; but it is so, and many details are added in various returns emphasising the assertion. One of the commonest of these is to the effect, 'If I could draw, I am sure I could draw perfectly from my mental image.' That some artists, such as Blake, have really done so is beyond dispute, but I have little doubt that there is an unconscious exaggeration in these returns. My reason for saying so is that I have also returns from artists, who say as follows: 'My imagery is so clear, that if I had been unable to draw I should have unhesitatingly said that I could draw from it.' A

foremost painter of the present day has used that expression. He finds deficiencies and gaps when he tries to draw from his mental vision. There is perhaps some analogy between these images and those of 'faces in the fire.' One may often fancy an exceedingly well-marked face or other object in the burning coals, but probably everybody will find, as I have done, that it is impossible to draw it, for as soon as its outlines are seriously studied, the fancy flies away."

Illustrations of Extreme Cases. "Mr. Flinders Petrie, a contributor of interesting experiments on kindred subjects to *Nature,* informs me that he habitually works out sums by aid of an imaginary sliding rule, which he sets in the desired way and reads off mentally. He does not usually visualise the whole rule, but only that part of it with which he is at the moment concerned . . . I think this is one of the most striking cases of accurate visualising power it is possible to imagine.

"I have a few returns from chess-players who play games blindfolded; but the powers of such men to visualise the separate boards with different sets of men on the different boards, some ivory, some wood, and so forth, are well known, and I need not repeat them. I will rather give the following extract from an article in the *Pall Mall Gazette,* 27th June, 1882, on the recent chess tournament at Vienna:—

'The modern feats of blindfold play (without sight of board) greatly surpass those of twenty years ago. Paul Morphy, the American, was the first who made an especial study of this kind of display, playing some seven or eight games blindfold and simultaneously against various inferior opponents, and making lucrative exhibitions in this way. His abilities in this line created a scare among other rivals who had not practised this test of memory. Since his day many chess-players who are gifted with strong and clear memory and power of picturing to the mind the ideal board and men, have carried this branch of exhibition play far beyond Morphy's pitch; and, contemporaneously with this development, it has become acknowledged that skill in blindfold play is not an absolute test of similarly relative powers over the board: e. g., Blackburne and Zukertort can play as many as sixteen, or even twenty, blindfold games at a time, and win about 80 per cent of them, at least. Steinitz, who beats them both in match play, does not essay more than

six blindfold at a time. Mason does not, to our knowledge, make any speciality at all of this sort.'

"I have many cases of persons mentally reading off scores when playing the pianoforte, or manuscript when they are making speeches. One statesman has assured me that a certain hesitation in utterance which he has at times, is due to his being plagued by the image of his manuscript's speech with its original erasures and corrections. He cannot lay the ghost, and he puzzles in trying to decipher it.

"Some few persons see mentally in print every word that is uttered; they attend to the visual equivalent and not to the sound of the words, and they read them off usually as from a long imaginary strip of paper, such as is unwound from telegraphic instruments. The experiences differ in detail as to size and kind of type, colour of paper, and so forth, but are always the same in the same person." . . .

Sex and Age Differences. "The power of visualising is higher in the female sex than in the male, and is somewhat, but not much, higher in public school-boys than in men. After maturity is reached, the further advance of age does not seem to dim the faculty, but rather the reverse, judging from numerous statements to that effect; but advancing years are sometimes accompanied by a growing habit of hard abstract thinking, and in these cases—not uncommon among those whom I have questioned—the faculty undoubtedly becomes impaired. There is reason to believe that it is very high in some young children, who seem to spend years of difficulty in distinguishing between the subjective and objective world. Language and book-learning certainly tend to dull it.

"The visualising faculty is a natural gift, and, like all natural gifts, has a tendency to be inherited. In this faculty the tendency to inheritance is exceptionally strong, as I have abundant evidence to prove, especially in respect to certain rare peculiarities, of which I shall speak in the next chapter, and which, when they exist at all, are usually found among two, three, or more brothers and sisters, parents, children, uncles, and aunts, and cousins." . . .

Improvements of Visualising. "There is abundant evidence that visualising faculty admits of being developed by education. The testimony on which I would lay especial stress is de-

rived from the published experiences of M. Lecoq de Boisbaudran, late director of the Ecole Nationale de Dessein, in Paris, which are related in his *Education de la Memoire Pittoresque.* He trained his pupils with extraordinary success, beginning with the simplest figures. They were made to study the models thoroughly before they tried to draw them from memory. One favorite expedient was to associate the sight memory with the muscular memory, by making his pupils follow at a distance the outlines of the figures with a pencil held in their hands. After three or four months' practice, their visual memory became greatly strengthened. They had no difficulty in summoning images at will, in holding them steady, and in drawing them. Their copies were executed with marvelous fidelity, as attested by a commission of the Institute, appointed in 1852 to inquire into the matter, of which the eminent painter Horace Vernet was a member. The present Slade Professor of Fine Arts at University College, M. Legros, was a pupil of M. de Boisbaudran. He has expressed to me his indebtedness to the system, and he has assured me of his own success in teaching others in a somewhat similar way.

"Colonel Moncrieff informs me that, when wintering in 1877 near Fort Garry in North America, young Indians occasionally came to his quarters, and that he found them much interested in any pictures or prints that were put before them. On one of these occasions he saw an Indian tracing the outline of a print from the *Illustrated News* very carefully with his knife. The reason he gave for this odd manœuvre was, that he would remember the better how to carve it when he returned home.

"I could mention instances within my own experience in which the visualising faculty has become strengthened by practice; notably one of an eminent electrical engineer, who had the power of recalling form with unusual precision, but not colour. A few weeks after he had replied to my questions, he told me that my inquiries had induced him to practise his colour memory, and that he had done so with such success that he was become quite an adept at it, and that the newly-acquired power was a source of much pleasure to him.

"A useful faculty, easily developed by practice, is that of retaining a retinal picture. A scene is flashed upon the eye; the memory of it persists, and details, which escaped observation

during the brief time when it was actually seen, may be analysed and studied at leisure in the subsequent vision.

"The memories we should aim at acquiring are, however, such as are based on a thorough understanding of the objects observed. In no case is this more surely effected than in the process of mechanical drawing, where the intended structure has to be portrayed so exactly in plan, elevation, side view, and sections, that the workman has simply to copy the drawing in metal, wood, or stone, as the case may be. It is undoubtedly the fact that mechanicians, engineers, and architects usually possess the faculty of seeing mental images with remarkable clearness and precision." . . .

Relation between Visualisation and Other Capacities. "I cannot discover any closer relation between high visualising power and the intellectual faculties than between verbal memory and those same faculties. That it must afford immense help in some professions stands to reason, but in ordinary social life the possession of a high visualising power, as of a high verbal memory, may pass quite unobserved. I have to the last failed in anticipating the character of the answers that my friends would give to my inquiries, judging from my previous knowledge of them; though I am bound to say that, having received their answers, I could usually persuade myself that they were justified by my recollections of their previous sayings and conduct generally."

Usefulness of Visualising. "The faculty is undoubtedly useful in a high degree to inventive mechanicians, and the great majority of those whom I have questioned have spoken of their powers as very considerable. They invent their machines as they walk, and see them in height, breadth, and depth as real objects, and they can also see them in action. In fact, a periodic action of any kind appears to be easily recalled. But the powers of other men are considerably less; thus an engineer officer who has himself great power of visual memory, and who has superintended the mathematical education of cadets, doubts if one in ten can visualise an object in three dimensions. I should have thought the faculty would be common among geometricians, but many of the highest seem able somehow to get on without much of it. There is a curious dictum of Napoleon I. quoted in Hume's *Précis of Modern Tactics,* p. 15, of which I

can neither find the original authority nor do I fully understand the meaning. He is reported to have said that 'there are some who, from some physical or moral peculiarity of character, form a picture (*tableau*) of everything. No matter what knowledge, intellect, courage, or good qualities they may have, these men are unfit to command.' It is possible that *tableau* should be construed rather in the sense of a pictorial composition, which, like an epigrammatic sentence, may be very complete and effective, but not altogether true.

"There can, however, be no doubt as to the utility of the visualising faculty when it is duly subordinated to the higher intellectual operations. A visual image is the most perfect form of mental representation wherever the shape, position, and relations of objects in space are concerned. It is of importance in every handicraft and profession where design is required. The best workmen are those who visualise the whole of what they propose to do, before they take a tool in their hands. The village smith and carpenter who are employed on odd jobs employ it no less for their work than the mechanician, the engineer, and the architect. The lady's maid who arranges a new dress requires it for the same reason as the decorator employed on a palace, or the agent who lays out great estates. Strategists, artists of all denominations, physicists who contrive new experiments, and in short all who do not follow routine, have need of it. The pleasure its use can afford is immense. I have many correspondents who say that the delight of recalling beautiful scenery and great works of art is the highest that they know; they carry whole picture galleries in their minds. Our bookish and wordy education tends to repress this valuable gift of nature. A faculty that is of importance in all technical and artistic occupations, that gives accuracy to our perceptions, and justness to our generalisations, is starved by lazy disuse, instead of being cultivated judiciously in such a way as will on the whole bring the best return. I believe that a serious study of the best method of developing and utilising this faculty, without prejudice to the practice of abstract thought in symbols, is one of the many pressing desiderata in the yet unformed science of education."

[Taken from Galton, F., *Inquiries Into Human Faculty* by permission of the publishers, E. P. Dutton & Co., Inc., New York City.]

2. IDEATIONAL TYPES

Such investigations as those of Galton led to the view that people may be divided into "types" in respect to the kind of mental imagery they make use of. This theory was developed by various psychologists in an elaborate way such as is presented in the following passages from Meumann.

Concrete and Verbal Images. "All persons appear to think in either of two wholly different forms. These forms do not, however, alternate with each other in a fortuitous and purposeless fashion; but each comes into operation on certain definite occasions and for the realization of certain definite ideational purposes. We all think either in concrete images of former perceptions of objects or processes, or we think in words which we speak to ourselves. In the former case, consciousness is dominated by residua, after-effects, or traces of former sense-perceptions, and more or less original and novel combinations of these. This form of ideating is therefore called concrete or objective ideating. The ideas which dominate us in this case are subdivided, by psychology, into ideas of imagination and ideas of memory. They are ideas of memory when they appear to us to be subjective copies of objects or processes which we have formerly experienced. In ideas of imagination this trans-subjective reference to former impressions is lacking; and in the adult, ideas of imagination have not infrequently been found to have come into being from numerous combinations, cleavages, variations and fusions of former ideas of memory; so that they seem to be exceedingly complex structures, in which now one, now another, component idea predominates in consciousness, in consequence of the cohesion and constellation of ideas.

"Verbal thinking or thinking in words is wholly different from this sort of ideation; and it also takes place under circumstances which are different from those under which concrete or objective ideation occurs. Indeed, the two sorts of intellectual function are, in a certain sense, mutually exclusive and antagonistic to each other, as we shall see. We think chiefly in concrete or objective terms when we give free rein to our imagination, when we have no definite problem before us or when the problem is of purely concrete sort, when we go back

over our remembrances without attempting to recall any particular person or event. On the other hand, we think in words in the form of an unspoken, internal speech when we deliberately follow a definite train of thought; when we reflect upon scientific problems, and especially when our real thinking comes into operation in the form of judgments; when we converse or argue with anyone; when we, in any way, put ourselves in the position of a speaker; and particularly when we reproduce, in words, a verbal context which we have learned. But it seems to be chiefly the contrast between concrete imagination and abstract thought which constitutes the contrast between the two forms of ideation. In many persons, perhaps in all, the two forms of thinking are directly opposed to each other. The more concretely my imagination works, the more do my verbal images retreat to the background of consciousness; the more intent I am upon following an abstract train of thought, the more do I think in terms of internal speech. The two sorts of ideation are also opposed in habituation and in inclination. For days and weeks at a time my internal speech predominates; and for equally long periods, concrete imaginations or persistent remembrances crowd my auditory-motor imagery into the background. It is no wonder, then, that fundamental differences of individual endowment should have their foundation in the opposition between these two sorts of ideating. Artists and musicians seldom show an inclination toward scientific thinking; and leaders in science are usually indifferent artists. From the introspective analysis of numerous individuals of both groups, one can see clearly that concrete ideation is dominant in the artist, while verbal thinking is dominant in the scientist.

"The sort of activity which we have designated briefly as internal speech or verbal thinking is, in all probability, everywhere a thinking process in which verbal meanings are faint and indistinct, and in which, under certain circumstances, they may even be absent from consciousness. The internally spoken word is the mental representative of the meaning of the word; it is a substitute for a more accurate envisagement of verbal meaning. And we shall see that the manner in which words are imaged and employed as symbolic representatives of meanings may be wholly different in different individuals.

"In both sorts of ideation, in concrete-objective and in verbal

thinking, wide individual variations occur. These are chiefly and primarily due to the fact that the concrete sensory components of which words and ideas are made up differ radically from individual to individual. In the visualizer the parts of concrete or verbal images consist wholly or chiefly of memorial residues of visual experiences; in the auditory individual, on the other hand, the auditory images are dominant; and in the motor individual, vestiges of movement sensations or actual, if weak, repetitions of former movements constitute the essential content of consciousness. It must be borne in mind, however, that an individual who possesses chiefly concrete visual imagery does not, for that reason, proceed exclusively in a visual fashion in his verbal thinking, that is, he does not think solely in terms of visual images of written or printed words. The differences between the ideational types are, remarkably enough, of a much more complex sort; for instance, the concrete visual type of ideation may co-exist in any individual with verbal ideation of another sort,—with vocal-motor or with verbal auditory imagery. The asymmetrical development of individual endowment in ideation and in retention, which we are accustomed to call ideational type, must therefore be discussed both from the point of view of concrete ideating and of verbal thinking."

[Meumann, E., *The Psychology of Learning*, tr. Baird (D. Appleton and Company, New York, 1913), pp. 188–191. By permission.]

Schema of Types. Meumann presents the following schema of the various kinds of imagery he believed had been established, although he admits that "pure" types are rarely found.

"I. Types of Concrete Ideation

A. Pure Types:
   a. Visual.
   b. Auditory.
   c. Tactual-Motor—the latter perhaps differing according as they have to do with a motor ideation of movements or of forms. Individuals of this type ideate in terms of imitative, empathetic or copying movements, with or without an actual innervation of the muscles.

In addition to these three, there are perhaps types

which make use of elements from the gustatory and olfactory senses, and of organic sensations.

d. Gustatory.
e. Olfactory.
f. Emotional.

B. Mixed Types: Instances of these types have not been proven, beyond doubt, to exist.

"II. Types of Verbal Ideation

A. Pure Types:
   a. Visual—perhaps two forms: ideating in images of written or printed words; and, possibly, ideating in visual images of writing-movements.
   b. Auditory.
   c. Tactual-Motor—ideating in images of vocal movements; ideating in (kinæsthetic) images of writing movements, with or without innervations of movements.

B. Mixed Types: not yet clearly shown to exist.

"III. Combinations of Concrete and Verbal Ideational Types

A. Visual concrete ideation combined with auditory-motor verbal ideation: This is probably the most common type.
B. There may be other combinations of 1 and 2 of the above schema: but they are rare,—indeed the existence of such cases has not yet been demonstrated beyond a doubt.

"IV. Negative Combination Types in Concrete and Verbal Ideation

A. Auditory Verbal and Visual Concrete, both well developed, but the two incapable of being combined.
B. Auditory Concrete and Visual Concrete, both well developed, but the two incapable of being combined." . . .

Inaudi and Diamandi. "The nature of these types is very clearly shown by an accurate investigation of individuals who

possess a decided mental bent in some particular direction. Fortunate circumstances led Binet to make the acquaintance of two noted 'calculators' who employed processes of wholly different types in their mathematical operations. Binet first investigated the Italian, Inaudi, whose calculations were made without any participation of visual imagery; then the Greek, Diamandi, who accomplished enormous numerical operations almost exclusively by means of visual imagery. I have had an opportunity to make a study, of several hours' duration, of these two prodigies. Inaudi placed himself at my disposal in the Leipzig laboratory; and Diamandi visited me at my laboratory in Zurich. The results of my tests differ somewhat from Binet's in that he, probably under the influence of Charcot, concluded that Inaudi was a purely auditory calculator,—he called him a 'model auditory,'—while I found that he employs internal speech throughout, both speaking and hearing the numbers. And Binet regards Diamandi as a pure visual, while I found that in him, too, a trace of internal speech is present. But my results agree with Binet's in their essential features, particularly in finding that Inaudi is wholly lacking in visual images and that Diamandi works chiefly by means of visual images. These two mathematical prodigies are excelled by Dr. Ruckle, who has been investigated by G. E. Müller. Ruckle belongs to a mixed type, with predominant visual imagery; according to his own statements made to me during a brief investigation, Ruckle makes extensive use of mnemonic aids and of the mathematical relations of numbers."

[Meumann, E., *The Psychology of Learning*, tr. Baird (D. Appleton and Company, New York, 1913), pp. 205–6, 214–15. By permission.]

3. THE DOCTRINE OF A SINGLE TYPE

"Why, it may be asked, does psychology not take actual whole natures and state how they differ? Why does psychology not describe human minds as zoölogy describes animal bodies, by classifying them into families, genera, and species, and by stating the differences between the different sorts of minds found?

"It is true that zoölogy does not measure all animals in

length, then in weight, then in color, then in number of organs, then in number of bones, and so on through a list of particular traits. It began with types or sorts apparent to common observation, such as worms and fishes, and described their essential features and the characteristic differences of one sort from another. And it is true that psychology might try to do likewise. If there were types or sorts of minds equally apparent to common observation, it would surely be worth while to start a description of human nature's varieties with them. But there are no sorts or types of minds that stand out clearly as birds, fishes and worms do amongst animal forms.

"*A Sample Problem: Individual Difference in Imagery.* As a sample of the problems and their treatment we may take the natures of individuals in respect to type of imagery, that is, in respect to the combination of:—vividness of visual images, fidelity of visual images, frequency of visual images, vividness of auditory images, fidelity of auditory images, and so on, through the list.

"Early in the history of the scientific study of imagery it was noted that certain individuals were able to recall in memory presentations to one sense with a high degree of vividness and fidelity, but lacked this power in the case of presentations to some other sense. The existence of persons who, for instance, could get before the mind's eye vividly and with full detail a mental photograph, as it were, of a scene, but could not thus reproduce from within a melody, an itching nose, or a blow, naturally gave rise to the notion of the 'visualizing type.'

Extreme Individual Differences in Imagery Rare. "Such cases, of notable ability to get one sort of images and notable inability to get other sorts, were then carelessly assumed to be the rule. It was supposed that a high degree of vividness, fidelity and frequency in images from one sense tended to exclude an equally high degree in images from other senses. People were called visualizers, audiles, motiles, etc., with the meaning that the visualizers had more vivid, faithful and frequent visual images than other people and less vivid, faithful and frequent images from other senses, and similarly for the audiles, or motiles. . . .

"But the actual examination of individuals showed such exclusiveness or predominance of one sort of imagery to be the

exception rather than the rule. To even superficial examination it was evident that human natures did not fit into the scheme . . . at all well. Even those who believed unhesitatingly that human natures must be distributed around fairly distinct types in respect to imagery could not, try as they might, distribute individuals around these types. Meumann in fact admits that in all his studies of children he never found one such pure type. 'How rare the pure types (of imagery) are amongst children is witnessed by the fact that in our extensive investigations of children at Zurich we have never found a perfectly pure type. Also I know of no case in the entire literature of the subject in which sure proof is given of the existence of a pure type in the case of children.' So new intermediate types, such as the auditory-motor, visual-motor, auditory-visual, or even visual-auditory-motor-intellectual, were introduced. There the matter remained until Betts actually measured a sufficient number of individuals in respect to the vividness and fidelity of non-verbal images from the different sense-fields. . . .

"The pillars of the doctrine were the separation of men into types according to the predominance of images from one sense, and the existence of inverse relations between the different sense-spheres in respect to the extent and perfection of imagery. Fact showed opinion to have been grossly in error as a result of its assumption that distinct types of some sort there must be. The contrary is true. Instead of distinct types, there is a continuous gradation. Instead of a few 'pure' types or many 'mixed' types, there is one type—mediocrity. Instead of antagonism between the development of imagery from one sense and that from other senses there is a close correlation. . . .

"This case is instructive because the fate of many theories concerning distinct types of human nature in combinations of traits is likely to be the same as the fate of the doctrine of types of imagery according to the sense involved, with inverse relations between the development of imagery from one sense-field and that from other fields. In the case of temperament, for example, we have the same history. Extreme cases are given names and made into types. Verbal contrasts are supposed to have real existence. Supplementary types are invented to help out the discrepancies between the imagined types and the real distribution of individuals. And it is highly probable that,

when actual measurements are made, mediocrity—a temperament moderately sanguine, choleric, phlegmatic, and melancholy; moderately slow, quick, shallow, intense, narrow and broad; moderately slow-shallow, slow-intense-narrow; moderately everything,—will be found to be the one real type.

"*The Theory of Multiple Types and the Single-Type Theory.* The sample problem shows well two extreme views which may be taken of the varieties of human natures, of the same sex, race and degree of maturity, in respect to any combination of traits. On the one hand is the theory of multiple types, a theory which separates a man by naming the class to which he belongs. On the other hand is the theory of a single human type, a theory which joins all men one to another in a continuity of variation and describes a man by stating the nature and amount of his divergences from the single type.

"By the theory of a single type, one make-up can be conceived such that from it all individuals would differ less than they would from any other one make-up, and such that, the greater the divergences, the rarer they would be. By the theory of multiple types, no such single true central tendency would exist. By the theory of multiple types, if a number, *K*, of 'typical' natures or make-ups are the most favorably taken and if divergences of all individuals are measured from, in each case, that nature which the individual most resembles, the total sum of divergences is enormously reduced below what it would be if they had been measured all from some one nature. By the theory of a single type, this reduction in the sum of divergences due to measuring each individual's divergence from any one of *K* natures, is much less." . . .

Arguments for Single Type. "Since, however, many writers about human nature openly or tacitly assume the truth of the multiple type theory in a pronounced form, and are governed by it in their methods of research, of interpretation and of practical control, it will be useful to consider briefly some of the arguments in favor of the single type theory.

"The first is the fact that, in proportion as exact measurements have been applied, evidence expected to favor the multiple theory has turned out in favor of the single type theory. It is true that such cases are very rare, and that, until they are much increased in number, little should be inferred from them.

But the fact remains that the single type theory arose from exact measurements, while its opposite came from speculative prepossessions.

"The second is the rarity of the inverse correlations between desirable traits upon which so many of the supposed multiple types are based. We know that eye-minded and ear-minded, quick and careful, broad and deep, sensorial and intellectual, men of thought and men of action, and the like do not really represent human nature's varieties in the combinations referred to. . . .

"The third is the fact that investigators who are strongly in favor of the multiple type theory and accustomed to interpret facts in harmony with it, yet find so few actual cases of it. Meumann, for instance, clearly accepts the theory in general and demands that educational practice should give much attention to the classification of pupils under distinct types. But in concrete particulars he rarely illustrates it.

"He says: 'By establishing types we orient ourselves in the endless possibilities of individual differences, and if we can place an individual under a type . . . in any respect we thereby have pointed out a group of universal characters in his mental life, which he in general shares with some individuals and by which he is in general distinguished from others. But he does not establish such types. The majority of the differences which he does report as 'typical' are differences between two extremes of the same trait. Intermediate conditions are in some of these cases demonstrably, and in all cases probably, more typical than the supposed types. And this, indeed, Meumann, in some cases, admits.

"Lastly, I may mention the fact that satisfactory proof of the existence of a distribution of human individuals after the fashion demanded by the multiple type theory has never been given in a single case, and that the evidence offered by even the most scientific of the theory's adherents is such as they would certainly themselves consider very weak if they were not already certain that types of some sort there must be. Thus a fair-minded perusal of Stern's *Psychologie der Individuellen Differenzen,* designed to be a description of the types into which human nature falls, is an almost sure means of stimulating a shrewd student to the suspicion that intermediate conditions

are more frequent than the supposed types, and that there are far more simply ordinary people than there are of all the 'types' put together.

"Thus Stern says, 'We know the enormous gap which exists between the unmusical and the musician in the discrimination of pitch, between the perfumer and the ordinary person in the recognition of odors, between the painter and the book-worm in the delicacy of color perception.' On the contrary, between the keenest of the non-musical and the dullest of musicians in the discrimination of pitch there is no enormous gap, but an enormous overlapping. . . . Stern himself later points out that a little special practice bridges the 'enormous gap.'

"Stern mentions (p. 46) 'the types of the external observer (the experimental scientist, possibly) and of the introspective thinker (the mathematician or metaphysician, possibly).' But these are not distinct, contrasting types. The experimental scientist is far more likely to be a good mathematician than is the ordinary man. Mathematical ability and interest are in no sense confined to the metaphysicians. The good external observer may be excellent at introspection, and the man with a strong interest in his inner life of thought is much more likely than the average man to have a strong interest in external facts."

[Thorndike, E. L., *Educational Psychology*, Briefer Course (Teachers' College, Columbia University, New York, 1914), pp. 411–420. By permission.]

It appears from these considerations that only in a few unusual cases can persons be regarded as visualizers, audiles, etc., in the sense that practically all of their imagery is of one kind. The individual differences in respect to mental imagery are so varied that, at least in the present state of knowledge of the matter, it is impossible and in most cases unnecessary to vary instruction in accordance with these varying conditions.

4. INDIVIDUAL DIFFERENCES IN IMAGERY AND TEACHING *

Presentation of Material in Relation to Imagery Type. "After the early studies on mental imagery became known, there fol-

* Starch, D., *Educational Psychology*, revised edition. By permission of The Macmillan Company.

lowed considerable theorizing as to types of persons and types of learners, and with it came the resulting endeavors to make applications of these theories to methods of teaching. Thus it was said that if a pupil has difficulty in learning to spell or in learning a foreign language, he may be devoid of, or weak in visual imagery; or if he has trouble in learning to write, he may be short on motor imagery; or if he finds it hard to learn the pronunciation of words, he may be defective in auditory images and strong in motor imagery and should therefore turn to manual training. The proposed remedy was that the material to be learned should be presented to a different sense organ so that the pupil might use the imagery natural to him. All these inferences may possibly be true; but later additions to our knowledge of mental images make us more hesitant regarding the real part played by them in learning and concerning the actual differences produced by presenting material to different sense avenues."

Objections to this View. "Before we can make changes in practice we must be sure of the principles upon which the practice is based. It is important, therefore, to examine at least the following three considerations:

"In the first place, more careful studies of the sorts of images employed by different individuals show that the classification of persons into visuals, audiles, motiles, and so on, is fundamentally misleading. Studies by Betts and others have helped greatly to clarify the matter by showing that pure types rarely exist. . . .

"In the second place, recent inquiries indicate that images of the class most natural or predominant for a given person may be aroused by stimuli coming through another sense. For example, auditory stimuli may arouse visual images as well as, or even more readily than, auditory images if visual images are more natural to the individual. Miss Abbott found in a detailed investigation with four subjects, on the memory consciousness in orthography that 'irrespective of the method of presentation and the manner of learning, the typical mode of recall for all observers was through the visual imagery of the letters.' * Consequently it does not follow that, even if a person

* Abbott, E. E., "On the Analysis of Memory Consciousness in Orthography," Vol. XI No. 1. Psychological Monograph (1909). By permission.

has a strong leaning toward one or another type of imagery, it is necessary or even advantageous to present the material to be learned through the sense avenue of the favorite type of imagery.

"Colvin and Meyers * made an extensive series of tests with school children to ascertain to what extent visuals retain visual material best, audiles auditory material, and motiles motor elements. They concluded that:

" 'There seems to be a fairly definite relation between the effectiveness of memory in the case of a particular ideational type and the memory material which is most suited to that type. In particular the visual type retains best material with a visual content and the auditory and motor types, to a less degree, material with an auditory or motor content, as the case may be.'

"While this conclusion is probably justified, the differences among the various types of elements retained by the different groups of pupils are in the most instances small."

Henmon's Investigations. "In the third place, the most advantageous mode of sensory presentation for a given person is not necessarily the one that corresponds to his dominant type of imagery. Much of the experimental evidence that has been accumulated on the problem of modes of presentation of the learning material is conflicting in character. It is uncertain whether visual, auditory, motor, auditory-motor, or visual-auditory-motor presentations are most advantageous. Henmon has reported an experiment which has thrown important light upon the problem. He employed four methods of presentation, visual, auditory, visual-auditory, and visual-auditory-motor; and used three sorts of material, concrete nouns, two-place numbers, and nonsense syllables presented to six subjects with one, two, or three repetitions.

" 'In the visual presentation the subjects read the stimuli directly from the rotating drum and immediately wrote down as many members as could be recalled and in the order presented. The subjects were asked to repress movements of articulation. In the visual-auditory presentation the subject both saw the stimuli and heard them read by the experimenter. In

* Colvin, S. S. and Meyers, G. C., "Development of Imagination in School Children," Vol. XI No. I (1909), Psychological Monographs. By permission.

the visual-auditory-motor presentation the subject himself read the lists aloud.' *

"His results summarized thus:

" '1. Auditory presentation is clearly superior to visual presentation in immediate memory of adults, a result attributable to the greater ease and freedom of visualization with auditory presentation and the greater effort of attention required.

" '2. This superiority of auditory over visual presentation holds for all materials (nouns, nonsense-syllables, numbers), for all subjects irrespective of image type, and for one, two and three presentations. This result is not in accord with the opinion commonly held that visual presentation is superior, especially with meaningless material.

" '3. Combined visual-auditory presentation is slightly inferior to the auditory alone and decidedly superior to the visual alone. The advantage of a combined method is very much less than that shown in earlier investigations.

" '4. Visual-auditory-motor presentation is slightly inferior to the auditory and the visual-auditory presentations and superior to the visual alone. Articulation or vocalization is of little value for immediate memory.

" '5. The correlations of abilities with different forms of presentation are positive and very high, superiority with one indicating practically the same degree of superiority with another.' (After Henmon.)"

[Starch, D., *Educational Psychology*, revised edition (The Macmillan Company, New York, 1927), pp. 181–184. By permission.]

Causes of Individual Differences. Individual differences in mental capacities may be due to any or all of five factors, namely, (1) maturity, (2) sex, (3) family inheritance, (4) racial inheritance, (5) environment. Differences due to maturity are obvious in persons, especially children, of varying ages, but they are also present in children of the same chronological age, since some children mature more rapidly than others. Among the more striking differences in rate of maturing are the well-known differences between girls and boys in age at

* Henmon, V. A. C., "Relation between Mode of Presentation and Retention," Vol. 19 pp. 79–96 (1912). By permission of Psychological Review.

which they arrive at adolescence. Discussions of the influence of sex and race complete the topics of this chapter.

Chapter VI is devoted to the general discussion of family and environmental factors.

5. DIFFERENCES DUE TO SEX *

"*The Contributions of Sex.* Another factor operative in producing the original nature of an individual is the fact of sex. That men and women are different, that their natures are not the same, has long been an accepted fact. Out of this fact of difference have grown many hot discussions as to the superiority of one or the other nature as a whole. The present point of view of scientists seems well expressed by Ellis when he says, 'We may regard all such discussions as absolutely futile and foolish. If it is a question of determining the existence and significance of some particular physical or psychic sexual difference, a conclusion may not be impossible. To make any broad statement of the phenomena is to recognize that no general conclusion is possible. Now and again we come across facts which group themselves with a certain degree of uniformity, but as we continue, we find other equally important facts which group themselves with equal uniformity in another sense. The result produces compensation.' †

"The question of interest then is, what in nature is peculiar to the male sex and what to the female? What traits will be true of a boy, merely because he is a boy, and vice versa? This has been an extremely difficult question to answer, because of the difficulty encountered in trying to eliminate the influence of environment and training. Boys are what they are because of their original nature plus their surroundings. Some would claim that could we give boys and girls the same surroundings, the same social requirements, the same treatment from babyhood, there would be no difference in the resulting natures. Training undoubtedly accentuates inborn sex differences and it is true that a reversal of training does lessen this difference;

* Norsworthy, N., and Whitley, M., *The Psychology of Childhood.* By permission of The Macmillan Company.

† Ellis, Havelock, *Man and Woman.* By permission of The Macmillan Company.

however, the weight of opinion at present is that differences in intellect and character do exist because of differences of sex, but that these have been unduly magnified. H. B. Thompson, in her investigation entitled *The Mental Traits of Sex,* finds that 'Motor ability in most of its forms is better developed in men than in women. In strength, rapidity of movement, and rate of fatigue, they have a very decided advantage, and in precision of movement a slight advantage. . . . The thresholds are on the whole lower in women, discriminative sensibility is on the whole better in men. . . . All these differences, however, are slight. As for the intellectual faculties, women are decidedly superior to men in memory, and possibly more rapid in associative thinking. Men are probably superior in ingenuity. . . . The data on the life of feeling indicate that there is little, if any, sexual difference in the degree of domination by emotion, and that social consciousness is more prominent in men and religious consciousness in women.' *

"Pearson in his measurement of traits, not by objective tests but by opinions of people who know the individual, finds that boys are more athletic, noisy, self-assertive, self-conscious; less popular, duller in conscience, quicker-tempered, less sullen, a little duller intellectually and less efficient in penmanship. Heymans and Wiersma, following the same general method as Pearson, state their general conclusions that the female is more active, more emotional, and more unselfish than the male. 'They consider women to be more impulsive, less efficient intellectually, and more fickle than men as a result of the first two differences mentioned above: to be gifted in music, acting, conversation, and the invention of stories as a result in part of the second difference; and to think well of people and to be easily reconciled to them as a result of the third.' † Thorndike finds the chief differences to be that the female varies less from the average standard, is more observant of small visual details, less often color-blind, less interested in things and their mechanisms, more interested in people and their feelings, less given to pursuing, capturing, and maltreating living things, and more

* Thompson, H. B., *The Mental Traits of Sex.* By permission of The University of Chicago Press.

† Heymans & Wiersma, Zeitschrift fur Psychologie, trans. by Thorndike. Educational Psychology. By permission of Warwick & York.

given to nursing, comforting, and relieving them than is the male. H. Ellis considers the chief differences to be the less tendency to variability, the greater affectability, and the greater primitiveness of the female mind, and the less ability shown by women in dealing with the more remote and abstract interests in life. All the authors emphasize the smallness of the differences; and after all the striking thing is not the differences between the sexes but the great difference within the same sex in respect to every mental trait tested. The difference of man from man, and woman from woman, in any trait is almost as great as the differences between the sexes in that trait. Sex can be the cause then of only a fraction of the differences between the original nature of individuals."

[Norsworthy, N., and Whitley, M., *The Psychology of Childhood* (The Macmillan Company, New York, 1918), pp. 11–13. By permission.]

6. RACIAL DIFFERENCES IN MENTAL TRAITS

"One of the most agreeable and satisfying experiences afforded by intellectual pursuits comes from the discovery of a clean-cut distinction between things which are superficially much alike. The esthetic value of such distinctions may even outweigh their intellectual value and lead to sharp lines and antitheses where the only difference that exists is one of degree. A favorite opportunity for this form of intellectual exercise and indulgence is afforded by the observation of groups of men. The type of man composing each group—that is what we should like to find; and we hear much of the 'typical' scientist, the typical Englishman, or Frenchman, the typical southerner, the typical Bostonian. The type of any group stands as a sort of ideal within the group, and, more or less caricatured, as the butt of the wit of other groups. There is one peculiar fact about these types: you may have to search long for an individual who can be taken as a fair example. And when you have at last found the typical individual, you may be led to ask by what right he stands as the type of the group, if he is a rarity amidst it.

"If we would scientifically determine the facts regarding a group of men, we should, no doubt, proceed to examine all the individuals in the group, or at least a fair and honest representation of them. The first fact that meets us when we proceed

in this way is that the individuals differ from each other, so that no one can really be selected as representing the whole number. We do find, indeed, when we measure the stature or any other bodily fact, or when we test any native mental capacity, that the members of a natural group are disposed about an average, and few lying far above or far below it; and we thus have the average as a scientific fact regarding the group. But the average does not generally coincide with the type, as previously conceived, nor do the averages of different groups differ so much as the so-called types differ. Moreover, the average is itself very inadequate, since it does not indicate the amount of variation that exists within the group—and this is one of the most important facts to be borne in mind in understanding any collection of individuals. It is specially important in comparing different groups of men, since the range of variation within either group is usually much greater than the difference between the averages of the groups. The groups overlap to such an extent that the majority of the individuals composing either group might perfectly well belong to the other."

Racial Types Not Clear. "No doubt statements like this will be readily accepted as far as concerns the different nations belonging to the same race. One could not seriously doubt that the nations of Europe, though they might differ slightly on the average, would so much overlap one another that, except for language and superficial mannerisms, the great majority of the members of one nation might be exchanged with a majority from another nation without altering the characteristics of either. But when we extend our view to all the peoples of the earth, the case would at first appear quite changed. Certainly whites and negroes do not overlap, to any extent, in color of skin, nor negroes and Chinamen in kinkiness of hair, nor Indians and Pygmies in stature. Such specialization of traits is, however, the exception. Whites and negroes, though differing markedly in complexion and hair, overlap very extensively in almost every other trait, as for example, in stature. Even in brain weight, which would seem a trait of great importance in relation to intelligence and civilization, the overlapping is much more impressive than the difference; since while the brain of negroes averages perhaps two ounces lighter than the brain of Europeans, the range of variation within either race amounts to 25 ounces."

The Fallacy of the Average. "Our inveterate love for types and sharp distinctions is apt to stay with us even after we have become scientific, and vitiate our use of statistics to such an extent that the average becomes a stumbling block rather than an aid to knowledge. We desire, for example, to compare the brain weights of whites and of negroes. We weigh the brains of a sufficient number of each race—or let us at least assume the number to be sufficient. When our measurements are all obtained and spread before us, they convey to the unaided eye no clear idea of a racial difference, so much do they overlap. If they should become jumbled together, we should never be able to separate the negroes from the whites by aid of brain weight. But now we cast up the average of each group, and find them to differ; and though the difference is small, we straightway seize on it as the important result, and announce that the negro has a smaller brain than the white. We go a step further, and class the white as a large-brained race, the negro as a small-brained. Such transforming of differences of degree into differences of kind, and making antitheses between overlapping groups, partakes not a little of the ludicrous."

The Effect of Differences in Variability. "We seem to be confronted by a dilemma; for the group as a whole is too unwieldy to grasp, while the average, though convenient, is treacherous. What we should like is some picture or measure of the distribution of a given trait throughout the members of a group; and, fortunately, such measures and pictures can be had. Convenient and compact measures of variability are afforded by the science of statistics, and are of no less importance than the average. But still better, because closer to the actual facts, are graphic or tabular pictures of the distribution of the trait, showing the frequency with which it occurs in each degree. The distribution of a trait is for some purposes more important than the average. Let us suppose, for instance, that two groups were the same in their average mental ability, but that one group showed little variation, all of its members being much alike and of nearly the average intelligence, while the other group showed great variability, ranging between the extremes of idiocy and genius. It is evident that the two groups, though equal on the average, would be very unequal in dealing with a situation which demanded great mental ability. One master mind could

supply ideas for the guidance of the group, and his value would far outweigh the load of simpletons which the group must carry.

"If groups of men differ in average intelligence, this difference would have an influence on their effectiveness in mental work, and so, no doubt, on their advance in civilization. If groups differ in variability, this would probably have a still greater influence. There is one respect in which groups certainly do differ. They differ in size, and size is an important consideration, even from a purely biological point of view. The more numerous the individuals born into a group, the greater the absolute number of gifted individuals to be expected; and in some respects it is the absolute rather than the relative number that counts. Besides this, the larger the group, the greater the chance of its producing a truly effective genius, just as, in the experiments of Burbank and other breeders, a vast number of plants are grown, in order to increase the chance of sports occurring."

Special versus General Abilities. "One further consideration of this partly biological, partly statistical, nature should be brought forward before passing from preliminary remarks to the consideration of actual data. When the individuals composing a group are measured or tested in several traits, it is found that those who rank high in one trait do not always rank high in others. On the whole, there is more correspondence than opposition; an individual who ranks well in one trait is rather apt to rank well in others. The correlation, as we say, is positive, but it is far from perfect. The individuals most gifted with ability in war are not altogether the same individuals who are ablest in government, or in art or literature, or in mechanical invention. This fact is not only of importance in reaching a just conception of a group, but it should be considered in comparing different groups. The circumstances surrounding a group call for certain special abilities, and bring to the fore the individuals possessing these abilities, leaving in comparative obscurity those gifted in other directions. Judging the group largely by its prominent individuals, we get the impression that the group is gifted in certain lines, and deficient in others. A nation whose circumstances call for industrial expansion and the exploitation of natural resources gives prominence to those of its members who are successful in these pursuits, and leaves

in obscurity many who have native capacity for military leadership. Should war come to such a community, time and bitter experience are often necessary before the leadership can be transferred from the previously eminent men to those obscure and often despised individuals who are capable of doing best service in the new direction. This lack of perfect correlation between various abilities makes it difficult to judge of the capacity of a group of men by casual observation; and we must accordingly discount largely the appearance of specialization of mental traits in different people.

"All in all, the discovery of true inherent differences between races and peoples is an intricate task, and if we turn to the psychologist to conduct an examination of different groups, and to inform us regarding their mental differences, we must not allow him to present a hasty conclusion. His tests must be varied and thorough before we can accept his results as a serious contribution to this difficult subject. The psychologist may as well admit at once that he has little to offer; for, though the 'psychology of peoples' has become a familiar phrase, and though books have been written on the subject, actual experimental work has so far been very limited in quantity.

"One thing the psychologist can assert with no fear of error. Starting from the various mental processes which are recognized in his text-books, he can assert that each of these processes is within the capabilities of every group of mankind. All have the same senses, the same instincts and emotions. All can remember the past, and imagine objects not present to sense. All discriminate, compare, reason and invent. In all, one impulse can inhibit another, and a distant end can be pursued to the neglect of present incitations. Statements to the contrary, denying to the savage powers of reasoning, or abstraction, or inhibition, or foresight, can be dismissed at once. If the savage differs in these respects from the civilized man, the difference is one of degree, and consistent with considerable overlapping of savage and civilized individuals. The difference of degree calls for quantitative tests. But besides the traditional classification of mental powers, there is another of perhaps greater importance in studying differences between men. One individual differs from another not so much in power of memory, or of reasoning, or of attention, or of will, as in the sort of material to which he successfully

applies these processes. One gives his attention readily to mathematics; he remembers mathematics easily; he reasons well on mathematical subjects; his will is strong in excluding distracting impulses when he is in pursuit of a mathematical goal. He may show none of these powers, in a high degree, in relation to music, or business, or social life; whereas another, totally inefficient in mathematics, may show equal powers of mind in another subject. The capacity to handle a given sort of subject matter is in part determined by native endowment, but is very responsive to training, and therefore is hard to test, because only individuals with equal training in any subject can be fairly tested and compared as to their native capacity to handle that subject. Thus it becomes hard to contrive a test for musical or mathematical or mechanical endowment which could fairly be applied to races having diverse training in these lines. This difficulty, moreover, infects our tests for such general powers as memory or reasoning, for a test has to deal with some sort of material, and success in passing the test depends on the familiarity of the material as well as on the power of mind which we design to test. We may suppose, indeed, that all of our tests, founded as they are on material which is familiar to us, will be more or less unfair to peoples of very different cultures and modes of life. The results of our tests need to be discounted somewhat—exactly how much we can not say—in favor of the primitive peoples tested.''

[Woodworth, R. S., in *Science N. S.*, Vol. XXXI, pp. 171–174. By permission.]

QUESTIONS

1. Suppose Galton had addressed his questionnaire to you; what would you have replied?
2. Basing your view on your own experience, do you believe that capacity for visualization aids or lack of it hinders in the learning of certain subjects? Which subjects?
3. Should schools make an effort to train powers of visualization? Why?
4. In view of what Starch and Thorndike say concerning mental imagery, do you think that Galton overemphasizes the importance of visualization?
5. What is a type? Give arguments for and against the view that people are divided into types with respect to mental capacities.
6. Give reasons for and against the view that preferred forms of mental imagery should determine the mode of presentation of instructional material.

7. In view of what is known as to differences in the sexes in respect to mental capacities, should they have different sorts of education?
8. In what sense, if any, is there a typical Englishman, Frenchman, etc.?
9. Why is it important to consider "variability" in comparing races?
10. How do differences in capacities within a single race compare with differences between the average capacities of different races?

CHAPTER VI

NATURE AND NURTURE

It is the biologist who speaks with greatest authority on the fundamental problems of heredity. The author of the following quotation is a well-known biologist, especially noted for his contributions to the study of animal behavior. The student will find it advantageous to read, if possible, the entire article from which this excerpt is taken.

1. THE BIOLOGIST SPEAKS

Mendelism Inadequate. "Knowledge of heredity has changed fundamentally in the past few years; in consequence the relations of environment to heredity have come into a new light. What has gotten into the popular consciousness as Mendelism—still presented in the conventional biological gospels—has become grotesquely inadequate and misleading; its seeming implications as to the trivial rôle of the environment have become null and void.

"What happens in any object—a piece of steel, a piece of ice, a machine, an organism—depends on the one hand upon the material of which it is composed; on the other hand upon the conditions in which it is found. Under the same conditions objects of different material behave diversely; under diverse conditions objects of the same material behave diversely. Anything whatever that happens in any object has to be accounted for by taking into consideration both these things. Neither the material constitution alone, nor the conditions alone, will account for any event whatever; it is always the combination that has to be considered.

"Organisms are like other objects in this respect; what they do or become depends both on what they are made of, and on the conditions surrounding them. The dependence on what they

are originally made of we call heredity. But no single thing that the organism does depends alone on heredity or alone on environment; always both have to be taken into account."

Heredity Not a Force. "What an organism is first composed of comes directly from its parents; this is the reason why dependence on that composition has been called heredity. But this habit of speech has led to conceiving heredity as something in itself, an entity, a 'force,' something that itself does things—an error that has induced clouds of misconception. Possibly we should be better off with no such concept as heredity: then analysis would be correctly directed toward understanding, in organisms as in other things, in what ways there is dependence on the stuff they are made of: in what ways on the conditions in which that stuff is found. . . ."

Materials and Conditions Must Always Be Considered. "Not only what the cell within the body shall become, but what the organism as a whole shall become, is determined not alone by the hereditary materials it contains, but also by the conditions under which those materials operate. Under diverse conditions the same set of genes will produce very diverse results. It is not true that a given set of genes must produce just one set of characters and no others. It is not true that because an individual inherits the basis for a set of characteristics that he must have those characteristics. In other words, it is not necessary to have a certain characteristic merely because one inherits it. It is not true that what an organism shall become is determined, foreordained, when he gets his supply of chemicals or genes in the germ cells, as the popular writers on eugenics would have us believe. The same set of genes may produce many different results, depending on the conditions under which it operates. True it is that there are limits to this; that from one set of genes under a given environment may come a result that no environment can produce from another set. But this is a matter of limitation, not of fixed and final determination; it leaves open many alternative paths. Every individual has many sets of 'innate' or 'hereditary' characters; the conditions under which he develops determine which set he shall bring forth. So in man, the characteristics of an educated, cultured person are as much his inherited characteristics as are any that he has."

Effect of Varied Conditions on Fruit Flies. "These sweeping

statements are substantiated by precisely known facts in many organisms. In that animal whose heredity is better known than is that of any other organism, the fruit fly, individuals occur with hereditary abnormalities. The abdomen is irregular, deformed; the joints between the segments are imperfect. This is sharply inherited as a sex-linked character, so that it is known to be due to a peculiarity of one of the genes in the x-chromosome. If the father has this abnormality, all his daughters inherit it, but none of his sons do so. The daughters hand it on to half their sons and half their daughters, and so on.

"But the fruit flies in the laboratory usually live in moist air; this inheritance appears under those conditions. If they are hatched and live under dry conditions the abnormality doesn't appear—even in those daughters which indubitably inherit it. Clearly, it is not necessary to have a characteristic merely because one inherits. Or more properly, characteristics are not inherited at all; what one inherits is certain material that under certain conditions will produce a particular characteristic; if those conditions are not supplied, some other characteristic is produced.

"Similarly, some of the fruit flies inherit, in the usual Mendelian manner, an inconvenient tendency to produce supernumerary legs. But if those inheriting this are kept properly warmed, they do not produce these undesirable appendages. In the cold, only those individuals acquire the extra legs that have inherited the gene to which such are due; but even they need not do so, if conditions are right. In the same animal, some individuals have fewer facets in the compound eye than others do. The number of facets is found to be hereditary, in the sense that under the same conditions parents with few facets produce offspring with few facets, in the Mendelian manner. But the number also depends on the environment; individuals with the same inheritance show different numbers of facets, depending on the temperature at which they develop. If the individual A has a certain number of facets, while B and C have a different number, the same in both, it may be found that the difference between A and B is due to inheritance, while the same difference between A and C is due to environment. Such facts are typical; differences due in one case to heredity may be due in another to environment. There is no characteristic distinction between he-

reditary diversities and environmental diversities; whether a given instance belongs in one or the other category can be determined only by experimental analysis. . . ."

Education. "Beyond all other organisms, man is characterized by the possession of many sets of inherited characteristics; the decision as to which shall be produced depending on the environment. . . . The educated man has characteristics very diverse from those he would possess if uneducated. We say, when we think of this fact, that these are acquired characters, environmental characters, due to education. This is correct; but there is a tendency to go farther and say that these are not inherited characters, which is a mistake. The characteristics of the educated man are his native, inherited characters, just as truly as are any that he has. For all his characteristics depend on the conditions under which he develops, and would be diverse under different conditions, just as is true of the characteristics that develop under education. And the characters developed under education depend upon the hereditary materials derived from his parents, changing as these materials are altered, just as do all others. 'Hereditary' has no consistent meaning other than this."

Difficulty of Changing Conditions Prior to Birth. "Why it seems paradoxical to call the characteristics developed under education inherited, while we make no difficulty in thus designating the color of the eyes and the stature, lies in certain practical difficulties, not in any difference of principle. In the group of organisms to which man belongs there is an early period in which it is practically difficult to change effectively the conditions under which the organism develops, because it is enclosed within the mother's body, or within a resistant egg shell. So we have gotten accustomed to calling inherited those characteristics which are determined before it leaves its mother's body or the egg, while those determined later are called acquired characters. But this is an artificial distinction, based on practical considerations. In many organisms there is no such distinction into two periods; in them it is possible to alter the conditions at any period, even the earliest. And when this is done it is found that all characters depend on the conditions; that such fundamental characters as the number of eyes an animal has or the position of the eyes in the body may be altered. In fish, for example, two eyes, one at each side of the middle line, form as distinctly an inherited

characteristic as in man, yet fish can be subjected so early to changed conditions (as Stockard and others show) that the animal has a single median eye instead of two lateral ones; and many other equally striking changes are producible by changes in the chemical environment. If the fish lived continuously in these conditions they would regularly inherit a single median eye; the two lateral eyes would be looked upon as a rare abnormality, produced by special conditions and not inherited. In truth, all characters are as certainly due to the conditions of development as to the materials of the germ cells.

"If there were not practical difficulties in the way, similar fundamental changes of structure could be made in man or any of the higher animals. In these higher creatures, a time comes, before development stops, in which it is possible to change the conditions; that is, after what we call birth. And then it is found that changing the conditions does change the characteristics that later develop—exactly as the characteristics of the fish are changed by changing the conditions. We call this process education; if we could give the same education for many generations to a number of different human families, we should find that the characteristics resulting from education are inherited, just as are color of the eyes and form of the head; that they follow Mendelian rules, as do physical characters. Every creature has many inheritances; which one shall be realized depending on the conditions under which it develops; but man is the creature that has the greatest number of possible heritages. Or, more accurately, men and other organisms do not inherit their characteristics at all. What their parents leave them are certain packets of chemicals which under one set of conditions produce one set of characters, under other conditions produce other sets. In man, the number of diverse sets that may thus be produced is very great; although it is of course not unlimited. But what the limitations are can not be stated from general biological principles or from what we know of any other organisms; they can be discovered only by concrete studies of man himself."

[Jennings, J. S., in *The Scientific Monthly*, Vol. XIX (1924), pp. 225–6, 232–4, 234–6. By permission.]

One of the most difficult tasks for the student of the problem of this chapter is to draw conclusions from the various data

that have been collected. In the two statements concerning the Edwards family which follow, one may see how differently the same facts may be interpreted by different persons.

2. THE EDWARDS FAMILY *

"From two English parents, sire at least remotely descended from royalty, was born in Massachusetts Elizabeth Tuttle. She developed into a woman of great beauty, of tall and commanding appearance, striking carriage, 'of strong will, extreme intellectual vigor, of mental grasp akin to rapacity, attracting not a few by magnetic traits, but repelling' when she evinced an extraordinary deficiency of the moral sense.

" 'On November 19, 1667, she married Richard Edwards, of Hartford, Connecticut, a lawyer of high repute and great erudition. Like his wife he was very tall, and as they both walked the Hartford streets, their appearance invited the eyes and the admiration of all.' In 1691, Mr. Edwards was divorced from his wife on the ground of her adultery and other immoralities. The evil trait was in the blood, for one of her sisters murdered her own son, and a brother murdered his own sister. After his divorce Mr. Edwards remarried and had five sons and a daughter by Mary Talcott, a mediocre woman, average in talent and character and ordinary in appearance. 'None of Mary Talcott's progeny rose above mediocrity and their descendants gained no abiding reputation.'

"Of Elizabeth Tuttle and Richard Edwards the only son was Timothy Edwards who graduated from Harvard College in 1691, gaining simultaneously the two degrees of bachelor of arts and master of arts—a very exceptional feat. He was pastor of the church in East Windsor, Connecticut, for fifty-nine years. Of eleven children the only son was Jonathan Edwards, one of the world's great intellects, preëminent as a divine and theologian, president of Princeton College. Of the descendants of Jonathan Edwards much has been written; a brief catalogue must suffice; Timothy Dwight, president of Yale; Sereno Edwards Dwight, president of Hamilton College; Theodore Dwight Woolsey, for twenty-five years president of Yale College; Sarah,

* Davenport, C. B., *Heredity in Relation to Eugenics* (Henry Holt and Company, New York, 1911), pp. 225–8. By permission.

wife of Tapping Reeve, founder of Litchfield Law School, herself no mean lawyer; Daniel Tyler, a general of the Civil War and founder of the iron industries of north Alabama; Timothy Dwight, the second, president of Yale University from 1886 to 1898; Theodore William Dwight, founder and for thirty-three years warden of Columbia Law School; 'Henrietta Frances, wife of Eli Whitney, inventor of the cotton gin, who, burning the midnight oil by the side of her ingenious husband, helped him to his enduring fame; Merrill Edwards Gates, president of Amherst College; Catherine Maria Sedgwick, of graceful pen; Charles Sedgwick Minot, authority on biology and embryology in the Harvard Medical School, and Winston Churchill, the author of *Coniston.*' These constitute a glorious galaxy of America's great educators, students, and moral leaders of the Republic.

"Two other of the descendants of Elizabeth Tuttle through her son Timothy have been purposely omitted from the foregoing catalogue, since they belong in a class by themselves, because they inherited also the defects of Elizabeth's character. These two were Pierrepont Edwards, who is said to have been a tall, brilliant, acute jurist, eccentric and licentious; and Aaron Burr, Vice-President of the United States, in whom flowered the good and the evil of Elizabeth Tuttle's blood. Here the lack of control of the sex-impulse in the germ plasm of this wonderful woman has reappeared with imagination and other talents in certain of her descendants.

"The remarkable qualities of Elizabeth Tuttle were in the germ plasm of her four daughters also; Abigail Stoughton, Elizabeth Deming, Ann Richardson, and Mabel Bigelow. All of these have had distinguished descendants, of whom only a few can be mentioned here. Robert Treat Paine, signer of the Declaration of Independence, descended from Abigail; the Fairbanks Brothers, manufacturers of scales and hardware at St. Johnsbury, Vt., and the Marchioness of Donegal were descended from Elizabeth Deming; from Mabel Bigelow came Morrison R. Waite, Chief Justice of the United States, and the law author, Melville M. Bigelow; from Ann Richardson proceeded Marvin Richardson Vincent, professor of Sacred Literature at Columbia University, the Marchioness of Apesteguia of Cuba, and Ulysses S. Grant and Grover Cleveland, presidents of the United States.

Thus two presidents, the wife of a third and a vice-president trace back their origin to the germ plasm from which (in part) Elizabeth Tuttle was also derived, but of which, it must never be forgotten, she was not the author. Nevertheless, had Elizabeth Tuttle not been, this nation would not occupy the position in culture and learning that it now does.''

3. THE EDWARDSES AND THE JUKESES

''As a rule, the eugenists treat the Edwards family as if the stock began with the celebrated divine, Jonathan. The popular idea would seem to be that Jonathan was sent down from heaven, as it were, to originate a new line and demonstrate the potency of the germ-plasm. In common with many others, I have been considerably impressed, as I have read the books on eugenics, by the array of learning shown in the discussion of the Edwards family, but always there seemed to be something lacking. I was thus not satisfied, and determined to go a step further. After much investigation and deep thinking, I discovered that Jonathan Edwards had ancestors. In fact, he had a father and a mother, grandfathers and grandmothers—an ancestry running back to Adam, or in that general vicinity. Of course, the records of most of this ancestry have been lost in the mists that hang over all the past, but at least one can go a little way in tracing back his line.

''Jonathan Edwards' father was Timothy Edwards, a New England preacher, whose glory has been dimmed if not totally eclipsed by his son's. His mother was Esther Stoddard, of whom little is known except that she was the mother of Jonathan. He was one of eleven children. All the rest were girls. This being the case, the family name as well as the immaculate germ-plasm has been carried down through history by Jonathan himself. Timothy Edwards was in turn the son of Richard Edwards, an obscure New England merchant, and of one Elizabeth Tuttle. Timothy was the second of the seven offspring of this fateful couple.

''The eugenists stubbornly stick to the Edwards tree and the Edwards name in tracing the output of this remarkable family. Still, even some of the eugenists make it fairly plain that the Edwards family had little to do with the prodigies that

followed in the wake of Jonathan. As we shall see, the 'tilt toward greatness' in his line was given by Elizabeth Tuttle, his grandmother. Elizabeth Tuttle was not an Edwards, save that she took her husband's name. The important question then becomes: who and what was Elizabeth Tuttle? . . .

"However, Mr. Charles Benedict Davenport of the Carnegie Institute of Washington, who is really the outstanding exponent of eugenics in this country, has fortunately given us more information. His book, *Heredity in Relation to Eugenics,* was published in 1911; Mr. Wiggam's, by the way, was published in 1924. Is it possible that Mr. Wiggam could have overlooked the following statement by so eminent an authority as Mr. Davenport?

" 'From two English parents, sire at least remotely descended from royalty, was born in Massachusetts Elizabeth Tuttle. She developed into a woman of great beauty, of tall and commanding appearance, striking carriage, "of strong will, extreme intellectual vigor, of mental grasp akin to rapacity, attracting by not a few magnetic traits, but repelling" when she evinced an extraordinary deficiency of moral sense.

" 'On November 19, 1667, she married Richard Edwards of Hartford, Connecticut, a lawyer of high repute and great erudition. Like his wife he was very tall, and as they both walked the Hartford streets their appearance invited the eyes and admiration of all. In 1691 Mr. Edwards was divorced from his wife on the ground of her adultery and other immoralities. The evil trait was in the blood, for one of her sisters murdered her own son, and a brother murdered his own sister.'

"In view of the fact that in the discussion of the Jukes family . . . a great deal of emphasis is laid upon the criminal records and immorality of some of its members, it would seem that the family taking its origin from Elizabeth should have received a little more attention at its source. Probably most of the eugenists who believe that the human race should be tinkered with by way of improving on nature would have then united in the opinion that the line should have ended before it began.

"That it is really a Tuttle line and not an Edwards line is not a matter of dispute. Mr. Davenport goes on to say that 'after his divorce Richard Edwards remarried and had five sons and a daughter by Mary Talcott, a mediocre woman, average in talent and character and ordinary in appearance. None of

Mary Talcott's progeny rose above mediocrity and their descendants gained no abiding reputation.' This is quite a slam at Mary, but as she has been dead for 250 years she probably won't mind.

"In passing, I may remark on the doubtful chivalry of attributing to her the obvious inferiority of Richard Edwards, which manifested itself so plainly after he married her. Still this may be admissible in the cause of science. It is obvious, however, that her descendants by Richard Edwards were as much Edwardses as those coming from Richard and Elizabeth Tuttle. Yet, unfortunately, for the argument in favor of the potency of the Edwards germ-plasm, this second batch of Edwardses 'never rose above mediocrity.'. . .

"Jonathan, it will be remembered, was born in 1703. This was a little more than 200 years ago. If we count thirty years to a generation this means that we are now six or seven generations removed from the founder of this noble line. However, as we have already seen, it was not Jonathan who was the real founder, but Elizabeth Tuttle. This means that we are nine generations removed. Now, we know that Elizabeth had seven children by Richard Edwards, one of whom was Timothy. But Richard had six more children by poor little Mary Talcott, making his total score thirteen. Timothy Edwards, in turn had eleven children, one of whom, Jonathan, is the hero of our romance. Jonathan, in his turn, had five children. (This all happened before the Malthusian Law had been thought of.) In order to be fair, let us assume that the first three generations had only four children each who lived to have children of their own begetting (instead of the actual figures given above), and that thereafter, on down to the present generation, each member of the family bore three children, each of which lived long enough to preserve and carry down the precious Edwards germ-plasm.

"Theoretically, then, the descendants of Elizabeth Tuttle, living and dead, should number approximately 90,000 individuals. This assumes there have been no intermarriages in the family. (Which, of course, there have been, and with God knows whom else, mayhap even with the despised Jukeses! But, more of this in a moment.) To be perfectly safe, let us cut the figure to less than half. Let us take 40,000. We may then assume that, by the law of chances, half of the 40,000 descendants from Elizabeth are females. This means that about twenty thousand

new names have been brought into the Edwards line. Now, it is also obvious that with every marriage, both male and female, new blood has been brought into the Edwards stream of inheritance, and that in figuring out the laws of heredity attention should be given to the female line as well as to the male. Something like this has been done by the eugenists. An examination of the list of names given as descendants in the Edwards line reveals the fact that they have grabbed a name of more or less importance wherever they could find it. . . .

"What the eugenists have done here is to commit the most elementary error in logic: 'after this, because of this.' They have gathered a list of more or less well-known names appearing somewhere in the nine generations following Elizabeth Tuttle and have then assumed that in some way the precious germ-plasm of Elizabeth went into making these names 'great.' Suppose that some evil-minded person wished to show that Elizabeth Tuttle was the bearer of a defective germ-plasm? Such a person would only have to follow the methods and ape the commendable industry of the eugenists. It would be necessary only to pick out of the forty thousand or more individuals who might possibly have taken their origin from the Tuttle germ-plasm a number of idiots, imbeciles, morons, criminals, paupers and the like, and then lay the whole burden on Elizabeth Tuttle via Jonathan Edwards. This without regard to the endless mixture of the germ-plasm all the way down the line, or to the known effect of the social heritage in determining the life of every individual. If the effect of 'good' germ-plasm can be demonstrated in any such crude way as has been used in the case of the Edwards family, then anything can be shown which any writer wants to show."

[Darrow, Clarence, "The Edwardses and the Jukeses," *The American Mercury*, Vol. 6 (1925), pp. 147–148, 148–149, 151–153. By permission.]

Family resemblances in mental traits have been extensively investigated for the purpose of throwing light on the nature-nurture problem. In general, the results have been as perplexing and their interpretation as difficult as those made by other methods. Many studies have reported that twins are more alike in various forms of mental tests than are ordinary siblings. The most recent investigations, however, seem to show that it is only the so-called identical twins who have this greater sim-

ilarity in mental traits, and that ordinary twins are no more alike in this respect than siblings. Some studies have reported that children brought up in an orphanage are as much alike in mental traits as siblings while others report the contrary. Professor Dearborn in the following passage shows how cautious one must be in drawing conclusions from such studies.

4. THE STUDY OF TWINS

"*The Intelligence of Twins; Adequate Studies Needed.* 'Necessitarians,' said Galton, 'may derive new arguments from the life history of twins.' Galton himself thought, and many have since followed his lead in believing, that such studies give a decisive answer to the question of the relative potency of heredity and environment. According to his inquiries, similar twins became more alike and dissimilar twins less alike as they grew older, likenesses or differences in home and social environment having thus little or no effect on the outcome. Galton's information was secured from questionnaires. The returns were largely anecdotal in character and not convincing. Indeed, it is difficult to give credence to what appear to be trustworthy accounts when they are interspersed with such examples of naïveté and credulity as the following:

"(1) Twins of twenty-three were attacked by toothache at the same time and the same tooth had to be extracted in each case.

"(2) Twins, who lived two leagues apart, had the same dream at the same hour; both awoke with a violent start calling out, 'I have caught the thief'; both became insane at the same time; and one drowned himself at the very spot where the other had tried to do so a few hours earlier.

"(3) One twin, A, who happened to be in a town in Scotland, bought a set of champagne glasses, which caught his attention, as a surprise for his brother B; while, at the same time, B, being in England, bought a set of precisely the same pattern as a surprise for A.

"The twins last mentioned doubtless had similar tastes (or thirsts). In this country at the present day, they might more likely have purchased Clicquot Club Ginger Ale or Canada Dry—evidence of the greater power of nurture over nature (in this country).

"The more recent investigations of intellectual resemblances have been made by means of mental tests. The experimenters have assumed that, because of the common influences of the homes, schools, etc., environment, if it counts at all, should make older twins more alike than younger twins. This according to their interpretation of the findings is not the case. The actual figures are somewhat conflicting. Thorndike and Merriman found the older twins to be somewhat less alike, while Lauterbach, in the most recent and comprehensive study, finds them somewhat more alike—as far as general intelligence is concerned. If there is any merit at all in Galton's observations, these results might well depend on the proportions of similar and dissimilar twins in the groups compared. The experimenters agree that their differences are probably due to chance. There are, however, more cogent considerations which apply to these experiments. In the first place, the assumption that all homes are alike and that they all make for intellectual resemblances is at best a questionable one. There are circumstances and conditions which may quite as well make for differences as for resemblances. Further, in the experimental studies above cited, the older twins are not the same individuals as the younger; they are different pairs, and they have not had the same home environment. The result is a statistical average of unknown quantities or qualities. An adequate study will require not only repeated measurements of the same pairs of twins from birth, but also some actual account of the circumstances of the homes, of the school, and of other environmental factors which may be pertinent to the problem. The following account is offered in support of these criticisms. It brings to the fore but one of the possible factors.

THE RESULTS OF FIVE ANNUAL STANFORD-BINET EXAMINATIONS ON A PAIR OF TWINS

	HARRIET			HELEN		
	C.A.	*M.A.*	*I.Q.*	*C.A.*	*M.A.*	*I.Q.*
Feb., 1923.....	7–6	8–4	111	7–6	8–4	111
Jan., 1924.....	8–5	10–5	124	8–5	8–4	99
June, 1925.....	9–10	11–8	119	9–10	9–7	99
Jan., 1926.....	10–5	11–5	110	10–5	10–2	98
Dec., 1927.....	11–4	13–6	119	11–4	10–1	89

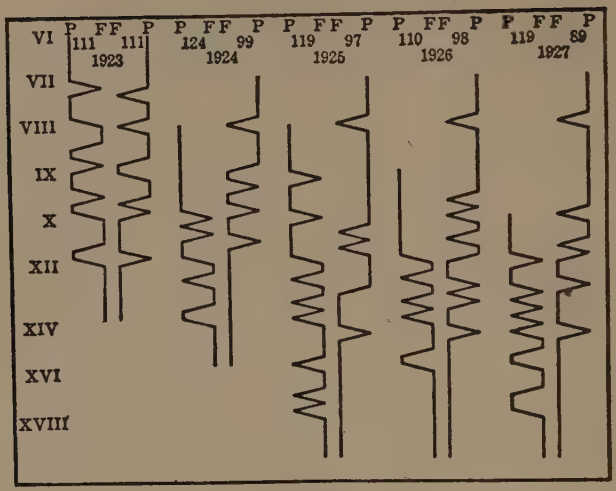

FIGURE 8

STANFORD-BINET PSYCHOGRAPHS OF HARRIET AND HELEN, A PAIR OF GIRL TWINS 11 YEARS OF AGE IN 1927.

P stands for pass; F for fail. The numbers indicate the year and the I. Q.

"In the figure above, the results of five annual examinations of the same pair of twins with the Stanford-Binet Intelligence Tests are shown in detail. In the first test, at the age of seven and a half, the general intellectual level was the same, a mental age of eight years and four months, or an I. Q. of 111. (See table on p. 117.) Even in the separate tests, there is a very considerable agreement as to those which are passed or failed by the twins, as may be seen from the 'psychographs' of the figure. In the following year, according to the tests, Harriet advanced a full two years in intellectual growth, while Helen remained stationary. Harriet has maintained her superiority during the three succeeding years in the Binet as well as in other intelligence tests, and in her work at school. In the latter, she has been consistently superior to her sister. These disparities in mental development seem to be due to differences in disposition. Helen is a pretty, sweet child with a charming smile and is the immediate favorite alike of teachers and playmates as she seems also to have been of her parents. Harriet lacks social

virtues and is apparently happier in school than at home. It appears likely that she is attempting to compensate for the social success of her sister by greater intellectual effort, and that her present intellectual superiority is a result of a long latent rivalry."

Advantage of Such Studies. "The chief advantage in the study of twins is the possibility of varying one of the complex factors at a time. If twins are alike in inheritance, then it may be possible to observe more accurately than in the case of other individuals the effect of differences in environment. It is now generally accepted that there is the same inheritance only in the case of the so-called identical, monozygotic (or one-egg) twins. Even in these cases, there is the possibility of differentiation between conception and birth. Finally, the means for the identification of identical twins after birth are at present entirely inadequate. Since, therefore, the factor of inheritance has not been held constant and no adequate account or control of environmental factors has been made, it is doubtful if the studies of twins have as yet offered any advantages over other experimental and statistical approaches toward the solution of the problem of the relative potency of heredity and environment."

[Dearborn, W. F., *Intelligence Tests* (Houghton Mifflin Company, Boston, 1928), pp. 285–289. By permission.]

If two persons are to learn a certain skill or mental performance such as is called for in a mental test, and it is assumed that one of them is superior in hereditary ability to learn this particular activity, it would seem to follow logically that equal amounts of practice for each would result in wider divergence of performance. Conversely, it would appear to be an argument in favor of the preponderant influences of heredity in producing individual differences if it is found that equal amounts of practice tend to increase such differences. Unfortunately, it is impossible to devise a learning test such that it can be taken for granted that the individuals taking the test start from the same point in respect to previous practice, since mental capacities are so universally interrelated. There have been, however, many investigations which have been interpreted as showing "that practice does not equalize abilities, but that, equal practice tends to increase differences in achievement and skill rather than decrease

them. This experimental fact is one of the most profound bits of evidence regarding the whole problem of heredity and environment." (Starch, D., *Educational Psychology*, p. 91.) This statement is quite too sweeping and dogmatic, as is shown by the following discussion.

5. DOES EQUAL TRAINING INCREASE INDIVIDUAL DIFFERENCES?

"A priori, the easy inference from the hypothesis of 'general intelligence' is that equal training applied to persons of varying degrees of initial ability will widen the differences in ability that existed at the outset. In other words, if one has by nature a certain quantum of ability to learn, any addition gained through exercise or training would seem to be directly proportional to the additional amount. Under the same conditions of training, then, the quick learner, it may be inferred, will progress so much more rapidly than the slow learner that the gap between them should increase rather than diminish. Under such conditions, indeed, the logical inference is that training would augment initial differences in a geometrical ratio,—that the final result would be even more than a sum of heredity plus environment, it would be a product of heredity times environment."

The Experimental Evidence Equivocal. "This plausible inference has seemed, in general, to be in harmony with the observed facts. When individuals of varying ability have been subjected to the same training under experimental conditions, it frequently has been found that the differences at the end of the training were apparently wider than at the beginning. In summarizing several experiments of this type, Thorndike reached a conclusion that has had a profound influence upon educational theory and practice:

" 'Equalizing practice seems to increase differences. The superior man seems to have got his present superiority by his own nature rather than by superior advantages of the past, since during a period of equal advantages for all he increases his own lead.' *

"Essentially the same position is taken by other authorities in the field. For example, Henmon:

* Thorndike, E. L., *Educational Psychology*, Vol. 3, p. 305. By permission of Teachers College Columbia.

" 'All experimental studies point in the direction that practice does not equalize abilities; in fact, equal practice tends to decrease them. The more gifted individuals profit more, both relatively and absolutely, than the less gifted.' " *

Mentality Distills Its Own Corrective. "The experimental evidence, however, is not entirely unequivocal in respect of this important issue. Some of the learning curves that have been reported show a clear tendency toward a decreasing rather than an increasing of the initial differences, and the facts of everyday life also add their testimony against the universality of the conclusion that equal training tends even more widely to separate individuals of varying capacities. These facts led the present writer in 1922 to make the statement quoted in Chapter II:

" 'One person, in commenting on my paper, asked this question, "How can you believe that, among all biological traits, mentality alone is not subject to biological variation?" Of course I hold no such belief; whatever the biological bases of mentality may be, they are certainly subject to the laws of variation; but, in so far as I am informed, mentality among all of the variable biological traits, seems to be the only one that distills its own corrective.'

"In January, 1923, in a joint discussion with Professor Thorndike before the faculty of Teachers College, this point of view was again set forth:

" 'Assuming that training sharpens inherited abilities, the obvious inference is that the same training given to persons of widely differing native abilities will still further separate them. And yet if we take a group of people who differ widely in inherited ability and have had the same training, we know that there are resemblances among them that mark them off distinctly from a group of people, also varying in native endowment, who have not had a common education. Here education has certainly created resemblances—and, I hasten to add, resemblances of a very important sort, for they constitute the prime conditions of social living, of a common understanding, and of collective activity of an effective type.' "

Education Creates Resemblances. " 'What constitutes the essential resemblances among the members of this educated group?

* Henmon as quoted by H. B. Reed, *Journal of Experimental Psychology*, Vol. VII, No. 3 (June, 1924). By permission.

In the first place, while it is possible that their common education working on their varying inheritances has resulted in wider differences among them in certain of their abilities than existed at the outset, they have in other ways been brought pretty close together. The reason may be this: The typical practice-curve picturing the growth that comes through training shows that growth is generally rapid at first and then gradually diminishes until the curve flattens out into a permanent plateau. Differences in native capacity clearly determine the time and effort that are essential to reach the maximum, but when the quick learner is approaching his maximum his speed is retarded, and the slow learner is catching up with him. While the slow learner may never reach the higher levels, it is clear that, in case of certain abilities, prolonged common training will have the effect of actually diminishing the differences which existed at the outset, and at the same time be profitable for all concerned. In other cases, of course, an effective working maximum may not mean the actual maximum that each individual can reach, and here the training of the quick learners can profitably stop while the slower learners are brought up as close to the working maximum as they can reach.' "

Chambers's Study of Observational Learning. "The writer then called attention to Chambers's study of observational learning and accuracy of report as substantiating in a measure his contention. Without going into the details of this study, it is sufficient here to say that systematic training in 'observation' and 'accuracy of report' led to marked improvement in these two abilities. When the results of the experiment were distributed on the basis of the initial intelligence of the learners, the following conditions were found:

" '. . . although the upper half of the class made goodly gains under the influence of our uniform scheme of training, still at the end of the training period in each case the lower half was much more nearly on a par with the upper half than at the beginning of the training, indicating that they had improved more rapidly than the better mentally endowed halves of our respective training groups.

" 'It is, then, the more poorly endowed who seem to reap the greatest benefit from such training, which suggests that the better endowed had already worked out for themselves a method of

improving their powers of observation, and have come to realize practically . . . the elements that make for improvement, while those possessing less native endowment have not been able to do this for themselves. But given the necessary help by special training and the necessary incentives . . . they show rapid improvement. The indication is that they would soon overtake the more fortunate half of our total group. Regardless, however, of what the cause may be, the fact remains that training in observation may be given with great success to that section of our school population which stands most in need of aid in this fundamental type of learning.' *

"The more recent studies not only confirm the position that the present writer took in 1922 and 1923, but in a quite unexpected fashion add strength to his contentions. Two investigators, apparently working quite independently of one another, have discovered that much of the experimental evidence used to support the theory that equal training increased individual differences is open to quite the opposite interpretation."

Reed's Analysis of the Experimental Literature. "H. B. Reed, reporting in 1924, took the data cited by Thorndike, Henmon, Starch, and others in substantiation of this theory and showed that merely changing the method of measuring improvements reversed the evidence of most of the experiments. Consider, for example, a simple case: At the beginning of a learning-experiment, a quick learner can solve (say) five problems an hour involving certain arithmetical operations new to him; a slow learner under the same conditions can solve (say) two problems; the difference in initial efficiency between the two learners, then, is three problems an hour. At the end of the period of training, assume that the quick learner can solve twenty-five problems an hour, and the slow learner fifteen; the difference in terminal efficiency between the two learners is ten problems. Measured in this way, equal training seems clearly to have increased individual differences. But change the method of comparison: at the outset, the slow learner had only two-fifths or forty per cent of the quick learner's efficiency; at the end of the

* Chambers, O. R., "Relation of Intelligence and School Training to Observational Learning and Accuracy of Report," Bull. Ext. Div. Indiana University, Vol. VII, No. 12 (August, 1922), p. 131. By permission.

period of equal training, he has fifteen twenty-fifths or sixty per cent of quick learner's efficiency. Is it not equally clear that the difference between the two has been decreased by the training?

"Reed does not use this specific illustration, but he does give a number of analogous cases taken from the published records of learning experiments which have been repeatedly cited to support the deterministic hypothesis that equal training increases individual differences. The absolute differences are frequently increased, but the relative differences are decreased almost as frequently. The exceptions, of course, are those cases in which the quick learner maintains a rate of progress that is always proportionally equal to or greater than his initial lead. These cases, however, are very rare in the published records.

"Reed concluded from his analysis of the experimental literature that various methods should be used for measuring the differences between the slow learner's progress and that of the quick learner. He devised three tests involving learning exercises of different degrees of difficulty which he applied to relatively large groups of college students. The two measures of difference that he believes most trustworthy are (1) 'the ratio of the high scores to the low scores at the beginning and at the end of practice,' and (2) 'correlations between initial performance and per cent of improvement.' Measured by these criteria, his results showed a general decrease of individual differences with training. He presents the following interpretations:

" 'In the simpler skills, at any rate those that are taught in our elementary schools and which are important for everyone in making a living and in discharging the duties of citizenship in a democracy, the evidence indicates clearly that equal training makes individuals more equal in spite of their differences in native capacity. Many and probably most inequalities of life could be reduced by giving everyone equal opportunities in education. But when it comes to difficult problems, requiring great mental ability . . . it is likely that here the achievements are more nearly proportional to native ability.' *

"Miss Kincaid in January, 1925, reported a similar analysis of the experimental literature embodying results from some

* Reed, H. B., *The Journal of Experimental Psychology*, Vol. VII, No. 3, p. 199 (June, 1924). By permission.

twenty-six separate investigations. On the basis of five possible methods of making comparisons between quick and slow learners, 'facts indicating a general tendency to increase differences are found under only one form of comparison,' while 'facts indicating a prevailing tendency to decrease' are found under four forms of comparison. Her conclusions are these:

" 'The general results of our analysis must be as follows. In the investigations of practice in various functions which we have attempted to study with a view of determining whether original nature or some environmental factor is causing the differences in achievement which we find among individuals, it has been found that in the main there is a tendency for the differences to decrease as the result of a period of equal amounts of training for the group.

" 'In a minority of the experiments there has been fair evidence of a slight tendency for the superior individuals to increase their lead with the addition of equal units of practice. In just one experiment (out of twenty-six) the evidence has pointed strongly to such a tendency.' " *

Ideals, etc., in Relation to Democracy. "The statement made by the present writer to the effect that 'mentality distills its own corrective' for germinal variations is thus pretty clearly substantiated even when one considers only variations in those mental traits that can be definitely classed as 'abilities.' Beyond these, however, there are other mental traits which defy classification under this strictly behavioristic rubric, but which are none the less real and none the less significant. Indeed, it is not too much to say that both equalities and inequalities in mental abilities are of far less significance to the theory and practice of democracy than are resemblances and differences in mental content, that is to say, in ideas, ideals, and standards. The dominant school of contemporary psychology refuses to recognize these terms as connoting mental traits, and consequently it is futile to quarrel with the psychologist for confining his discussions of individual differences to abilities—especially since the experiments so rigorously limited to abilities completely confirm our hypothesis. Neither the theory of education nor the theory of democracy, however, can well reject the terms 'ideas,'

* Kincaid, M., *Psychological Review*, p. 47 (Jan. 1925). By permission.

'ideals,' 'standards,'—terms which at least imply that mentality has something to do with conscious experience."

[Bagley, W. C., *Determinism in Education* (Warwick & York, Baltimore, 1925), pp. 149–155. By permission.]

QUESTIONS

1. How does Jennings define *heredity?*
2. Why is it true that "it is not necessary to have a certain characteristic merely because one inherits it"?
3. Illustrate the relation between inherited and environmental factors by citing experimental evidence concerning fruit flies.
4. Show how "the characters developed under education depend upon the hereditary materials."
5. Contrast man and the lower animals with reference to inherited possibilities.
6. What is the usual interpretation made from the genealogical data of the Edwards family? On what grounds does Darrow attack this interpretation?
7. Show why it is that the study of twins has not yielded definite conclusions regarding the relative importance of heredity and environment.
8. Give evidence for and against the view that equal amounts of practice tend to increase individual differences.

CHAPTER VII

INTELLIGENCE

While the word *intelligence* as used in everyday speech is no more difficult to define than many other words of our language, it is difficult to define it with the exactness necessary for scientific purposes, and in such a way as one may be sure what it is that is being measured in the application of such tests as are called "intelligence" tests.

1. THE DEFINITION OF INTELLIGENCE

Gradual Development of Concept. "It is well to insist upon the fact that the meaning of general intelligence has been a gradual growth and that we did not start with a clear definition of general intelligence set up by some psychologists and forthwith proceed to measure it by means of tests. We may say rather that the psychologist borrowed from everyday life a vague term implying all-round ability and knowledge, and in the process of trying to measure this trait he has been and still is attempting to define it more sharply and endow it with a stricter scientific connotation.

"As we go through the writings of Binet we do not find any well-formulated and standard definition of general intelligence, but rather numerous descriptions of it, now emphasizing one of its aspects and now another. For a long time, indeed, he did not seem to differentiate it clearly from knowledge, just as it is not at present clearly differentiated from knowledge in popular thought. Later on, this differentiation from knowledge creeps in, but only after he has had considerable experience with measuring intelligence by means of his scale of tests. Practical work with the scale made this differentiation necessary. This is a good example of the manner in which the meaning of the term 'general intelligence' is acquiring a definite psychological connotation."

Binet's Early Definitions. "Binet considered attention and

adaptation as the two most important factors in general intelligence, although we must not forget that he employs the term attention in a much wider sense than is ordinarily the case in psychology. One of his longest articles is devoted to a study of attention and adaptation in order to see how intelligent and unintelligent children differ in these two respects, and many of the tests he devised to bring out these differences were later found useful in his scale. Judgment, again, is a term Binet is fond of using and of emphasizing in his concept of intelligence. Intelligence, he says, 'is judgment, or common sense, initiative, the ability to adapt oneself.' * And again, 'To judge well, understand well, reason well—these are the essentials of intelligence.' 'Binet's definition emphasized three phases of behavior: (1) the ability to take and maintain a given mental set: (2) the capacity to make adaptations for the purpose of attaining a desired end; and (3) the power of auto-criticism.' Descriptions of this kind are Binet's contribution to a definition of general intelligence.''

Stern's Definition. ''It remained for the German psychologist Stern to give us one of the shortest definitions of general intelligence, and the one that is most commonly accepted at the present time. 'Intelligence is a general capacity of an individual consciously to adjust his thinking to new requirements.' † And again, and perhaps better, 'It is general mental adaptability to new problems and conditions of life.' By this definition Stern differentiates general intelligence from talent which is the development of a specific ability, and again from knowledge or mere information, and lastly from memory because this deals with the old, whereas general intelligence is directed toward the new. Further he says, 'Any sort of perceptive, memorial or attentive activity is at the same time an intelligent activity just in so far as it includes a new adjustment to new demands.' These statements of Stern are often further contracted as follows: 'General intelligence is the ability of the organism to adjust itself adequately to new situations,' and this is our best definition at the present time. Obviously we could debate at length

* Binet, A. and Simon, T., *The Development of Intelligence in School Children.* Trans. by E. S. Kite, pub. by The Training School. By permission.

† Hollingworth, L. S., *The Psychology of Subnormal Children.* By permission of The Macmillan Company.

as to what is meant by 'adequately' or 'adjust' or 'new,' but such debate would lead us too far afield and serve no practical purpose.

"The definition given conceives of general intelligence as including behavior that leads to better and better adaptation not only in man, but in the whole animal kingdom. It includes the capacity for getting along well in all sorts of situations. This implies ease and rapidity in making adjustments and, hence, ease in breaking old habits and in forming new ones. Fundamentally, this leads us back to the general modifiability of the nervous system. An organism whose nervous system is very modifiable, can adjust itself to new types of situations and react adequately to a great number of different situations. The intelligent organism has a multiplicity of responses; the unintelligent few. The intelligent organism responds to a great number of situations; the unintelligent to few. Intelligent behavior leads one from one thing to another in ever-widening circles; unintelligent behavior is narrow and restricted, and leads to repetition or cessation.

"*Other Definitions.* Many other definitions of intelligence have been suggested. A number of these have been published in a Symposium on Intelligence in the *Journal of Educational Psychology.** Most of the writers prefer not to give a short definition but to describe what they mean by intelligence at greater length. Among the shorter definitions we find a few as follows:

'We may then define intellect in general as the power of good responses from the point of view of truth or fact.'—Thorndike.

'An individual is intelligent in proportion as he is able to carry on abstract thinking.'—Terman.

'An individual possesses intelligence in so far as he has learned, or can learn, to adjust himself to his environment.'—Colvin.

'Intelligence is intellect plus knowledge.'—Henmon.

'Intelligence seems to be a biological mechanism by which the effects of a complexity of stimuli are brought together and given a somewhat unified effect in behavior.'—Peterson.

'Intelligence is an acquiring capacity.'—Woodrow.

Obviously these definitions overlap to some extent and contradict each other also to some extent.

"Woodworth describes what the subject in a test must do:—

* *Journal of Educational Psychology*, Vol. XII, Nos. 3 and 4, pp. 123–147 and 195–216.

'He has to see the point of the problem now set him, and to adapt what he has learned to this novel situation.' These two elements, 'seeing the point' and 'adapting oneself to a novel situation,' he includes under the general factor of responsiveness to relationships. And to this general factor he would add a second, namely, retentiveness.

"Ballard would define intelligence as 'the relative general efficiency of minds measured under similar conditions of knowledge, interest and habituation.'

"Wells says, 'Intelligence means precisely the property of so recombining our behavior-patterns as to act better in novel situations.' *

"These samples of definitions of intelligence must suffice. There are a great many more. We need only add a useful way of thinking of intelligence, particularly for the teacher, namely, as *ability to learn.* For the intelligence test is a good index of a child's ability to learn in school, if he is interested and willing."

[Pintner, Rudolf, "*Intelligence Testing* (Henry Holt and Company, New York, 1923), pp. 53–57. By permission.]

2. EXTREME DIFFERENCES IN INTELLIGENCE

Francis Galton. "The day before his fifth birthday, Francis Galton wrote the following letter to his sister:

" 'MY DEAR ADELE:

" 'I am 4 years old and I can read any English book. I can say all the Latin Substantives and Adjectives and active verbs besides 42 lines of Latin poetry. I can cast up any sum in addition and can multiply by 2, 3, 4, 5, 6, 7, 8, (9), 10, (11).

" 'I can also say the pence table. I read French a little and I know the clock.

" 'FRANCIS GALTON,
" 'February 15, 1827.' " †

"The only misspelling is in the word February. The numbers 9 and 11 are bracketed because one had been scratched out with

* Wells, F. L., *Mental Adjustments,* D. Appleton & Company. By permission.

† Terman, *The American Journal of Psychology,* Vol. XVII, p. 210 (1917), quoting Karl Pearson, *Life, Letters and Labors of Galton.* By permission.

a knife, and the other was covered by a bit of paper pasted over it.

"By the age of six, Galton was conversant with the *Iliad* and the *Odyssey*. At six and seven, he busied himself with collecting insects and minerals, which he is said to have classified and studied in more than a childish fashion. The following well-worded note proves that at the age of ten he was absorbed in religious questions:

" 'December 30, 1832.

" 'My Dearest Papa:

" 'It is now my pleasure to disclose the most ardent wishes of my heart, which are to extract out of my boundless wealth in compound, money sufficient to make this addition to my unequaled library:

The Hebrew Commonwealth by John	9
A Pastor Advice	2
Hornne's commentaries on the Psalms	4
Paley's Evidence on Christianity	2
Jones Biblical Cyclopedia	10
	27.'

"Notwithstanding his wonderful precociousness, this noted English scientist accomplished his best work at an advanced age. *Hereditary Genius* was published in his fiftieth year; *Natural Inheritance* in his sixty-eighth.

"Galton is only one among a vast number of men of genius who are known to have displayed exceptional ability in childhood. The majority of poets and musicians show their genius at a very early age. Tasso was famous at the age of eight and Southey wrote dramas before that age; at the age of three, Mozart took piano lessons; at four, he played minuets and composed short pieces; and at five, he performed in public.

"In the field of science and philosophy, among those who were famous in their youth are Lord Bacon, Kant, Locke, Berkeley, Descartes, Spinoza, and Lord Macaulay. Macaulay read incessantly at the age of three. At seven, he began *A Compendium of Universal History,* and at eight he wrote *A Treatise to Convert the Natives of Malabar to Christianity.* All of these men lived to a fairly advanced age and continued their creative work throughout their lives.

"I have referred particularly to Galton merely because he belongs to that group of geniuses of whom it is sometimes alleged that they show no signs of exceptional ability until late in life. Clearly in Galton's case, the idea that genius develops slowly is based on ignorance: Galton was a genius even in his boyhood. Whether with more abundant information we should find all men of genius to have been exceptional children, it is impossible to say. On the other hand, of those placed at the opposite extreme of intelligence, the feeble-minded, it may be said with assurance that their careers as adults are faithfully foreshadowed by the performances of their childhood, even of their very early childhood. And since our interest at present is in differences in intelligence which exist in children, it is well worth our while to consider the contrast between the early record of Francis Galton and the following one of a girl named Abbie, a case typical of high-grade feeble-mindedness of the sort that is not uncommon in the special classes of our city schools.

*Abbie.** "Admitted to the New Jersey Training School for Feeble-Minded Boys and Girls in 1900, at the age of eleven, Abbie was small for her age, left-handed, and awkward. She always put the same foot forward when going up or down stairs; she knew her letters but could not read; she could count to ten; she knew some color and form; and she sang a number of hymns learned at home. Her sight and hearing were normal and she was fond of playing. Among Abbie's more unfavorable characteristics were a bad memory and a poor power of imitation. She was gluttonous, untidy, untruthful, sly, and profane.

"Three months after her admission she could thread a needle and sew on buttons, could dust and rub floors a little, had learned to read *A man ran* and *I see a man* (sometimes), counted to twenty, and, with help, could do such number work as this:

1	2	3
1	1	1
–	–	–

"For ten years she went to school. 'For ten years,' runs the report, 'her teachers struggled heroically to give her a mastery of something. Little less than marvelous is the optimism and

* "Report of the New Jersey Training School for the Feeble Minded (1910)." *The Training School*, Vol. VII, p. 182 (1910).

faithfulness of those teachers! We see them struggling on month after month, not in that perfunctory way born of discouragement or conscious failure, but with that courage and cheerfulness which comes from grasping at every straw of encouragement, of progress, of fancied improvement. Had these teachers become discouraged, we would have to admit that perhaps the result might be due to that fact. But there is no sign of giving up in all these years. Within the last few months, however, there has appeared the feeling that Abbie has reached her limit. She will be twenty-two years old before long.

"'To-day she is still small for her age. She can braid cornhusks a little; can make a bed; can iron an apron; cannot count the cost of three one-cent stamps and three two-cent stamps with the stamps before her; cannot repeat five figures or a sentence of fifteen words; defines only in terms of use; can read a few sentences, spell a few words and write about twenty-five words from memory; knows the days of the week, but not the months of the year; and does not know how many fingers she has on both hands.'

"Francis Galton and little Abbie represent opposite poles of human intelligence; they typify the extremes and between them are any number of variations. The differences existing between individuals in regard to common sense, mental ability and character are enormous. Obviously, they are of the utmost importance in determining the constitution of society and the aims of education. These differences come most clearly to view in the successes and failures of adult life. What is opportunity for one man is discouragement for another; as one climbs to eminence, another, starting with equal opportunities, treads a path that leads him to the poor-house. The struggle of life constitutes the test, a test which some pass gloriously and others utterly fail. Adult life, however, merely emphasizes the existence of individual differences in endowment; it does not create them. For the most part these differences, determining factors in the careers of men and women, are present in early childhood. In almost any American school the children display nearly every degree of intelligence between the brilliant Francis Galton and the feeble-minded Abbie.

"Psychological and pedagogical investigations conducted during the last decade have clearly demonstrated the fact that chil-

dren of the same age and the same amount of schooling vary from one to five years or more in mental capacity as well as in their school grade, and that the number of children who differ widely from what may be termed the normal is very much greater than has been generally supposed. Of course the factors which determine the rank a child takes, whether in school or out of school, are innumerable. One child may enjoy better health than another, be better nourished and less easily fatigued, or have fewer physical defects. One child may study harder or with more interest and concentration of attention than another. Home environment is of great importance. A child reared in a slum, by ignorant or wicked parents incapable of training him properly, cannot fairly compete with one who is influenced from the first by culture and sane discipline. Again, the quality of a child's companions is a crucial element. Differences in intelligence may depend upon ability or disability in some particular mental function, such as the capacity for visualization or for rote memory. Countless circumstances and conditions affect a child's success in the innumerable performances which make up his life; but the most comprehensive and fundamental of them all, to which the tests must inevitably return, is, finally, his innate brightness or dullness."

[Woodrow, H., *Brightness and Dullness in Children*, J. B. Lippincott Company, Philadelphia, 1919), pp. 9–14. By permission.]

No teacher should use intelligence tests without a general knowledge of their principles of construction and use, together with the nature of their limitations. The following pages give a lucid and succinct exposition of these topics.

3. PRINCIPLES OF INTELLIGENCE TESTING

"The rapid development and extensive use of so-called intelligence tests during the past few years is one of the most striking and interesting facts in the field of educational psychology and one of the most significant in the province of school administration. Not only are psychologists to-day giving a large measure of their attention to devising, improving, and applying mental tests, but teachers and school administrators are employing these tests more and more to determine the ability of

school children to do school work. Indeed, there is a danger at present that the movement in the direction of intelligence testing may grow out of all bounds; that it may be misunderstood in theory and erroneously and even harmfully applied in practice. It is with the purpose of making somewhat clearer the nature of intelligence tests and of pointing out their value and their limitations that this chapter is composed.

"*What Is General Intelligence?* . . . Intelligence testing is concerned in determining what psychologists have termed 'general intelligence.' Just what general intelligence is may easily be misunderstood, although there is a fair, though by no means a perfect agreement in regard to the significance of the term. By the word general is commonly understood an innate ability or group of abilities that lie at the basis of the acquired intelligence of an individual. Intelligence itself is not inborn, only the capacity to become intelligent. For this reason some writers prefer the term 'mental tests' or 'mentality tests' to the term 'intelligence tests,' since these writers mean by mentality the inborn capacity of the individual to become intelligent, provided he has the proper environment in which his mentality can develop into genuine intelligence. General intelligence, or mentality, then is to be understood as a native endowment which makes it possible for the individual to become more or less intelligent on the basis of this endowment. If a child is 'born long' in general intelligence, then he may, under proper conditions, achieve high intelligence in his knowledge of, and contact with, the world and his fellows; if he is 'born short' in general intelligence, then, no matter how fortunate his surroundings, he will be doomed to acquire in contact with his environment only a modicum of knowledge and skill.

"While all competent authorities would agree that the expression 'general intelligence' designates inborn capacity to acquire intelligence in the various situations of life, they would disagree as to the further interpretation of this term, in regard to the significance not only of 'general' but also of 'intelligence.' There are some who hold that the word 'general' signifies a single inborn capacity to become intelligent in all situations; others that the term 'general' means nothing more than that a person is born with a large number of specific capacities, more or less related, which enable him to acquire intelligent behavior

in many different activities. The supporters of this first view, notably Spearman, Hart, and Burt, explain innate intelligence as a 'general common factor.' Similarly, Pyle has attempted to show that all individuals have a certain all-round learning capacity which is constant for different types of material. He believes that children and adults differ widely in innate learning ability, irrespective of the material learned, and that this ability is identical with, or closely related to, general intelligence. The writers who urge that general intelligence is an innate central capacity think of it as a single quality that may be transmitted, as the color of eyes is transmitted, from parent to offspring. Individuals inherit this all-round unitary capacity, and if it manifests itself more in one kind of activity than in another, this difference is not due to the fact that there are parts, or aspects, to general intelligence. The differences are due either to other inherited abilities or to the varying opportunities presented to the individual to learn in different fields of human activity. Specifically, if a child acts with great intelligence in his class in arithmetic and very stupidly in his class in music, this is not due to the fact that he had two kinds of innate intelligence, one for number and one for music, but rather to differences in opportunity to learn and interest in learning in these two fields or to specific inborn capacities which in one instance favor the development of his general intelligence and in the other hinder this development. For example, no matter what the general intelligence of the child might be, he could hardly be expected to become highly intelligent in his work in music if he were born with a poor sense of rhythm and with an innate inability to distinguish between tones varying in pitch. In such a case his general intelligence would have little or no opportunity to manifest itself in the face of so specific an inborn handicap."

Thorndike's Types of Intelligence. "While there are some who strongly hold to the view above outlined—that general intelligence is a unitary or central inborn factor—there are others who take the view that the term designates a large number of more or less closely related innate capacities to become intelligent in various life activities. Thorndike, in particular, advocates this view. He holds to a multiplicity of innate abilities that are related in varying degrees. He believes that between desirable single traits in a single individual there is a positive

relation. 'Having a large measure of one good quality increases the probability that one will have more than the average of any other good quality.' * The fact that the child has pronounced native ability in arithmetic is an indication that he will have more than average native ability in geography, even that he will be above the average in his moral qualities, but it is not certain that he will be. According to Thorndike, then, general intelligence is a term by which a large number of innate abilities to become intelligent may be classified, or arranged in a pigeon hole for purposes of convenience, because all the abilities so arranged are likely to be in some kind of agreement. More specifically, Thorndike believes that there are three main types of innate intelligence, namely, intelligence for words and abstract ideas; motor intelligence, or skill with the use of the hands; and social intelligence, or the ability to get on well with one's fellows. These three types are positively related, but not necessarily in a high degree. The first type concerns itself particularly with abilities necessary to get on in school and college in the ordinary academic courses and in the more abstract aspects of applied courses. The second type of ability concerns itself with the execution of skillful motor acts and the comprehension of mechanical constructions and processes. The third type has to do with the understanding of one's fellows and with influencing and leading them. In order to be an excellent mathematician or classical student one must be 'born long' in abstract intelligence; in order to handle tools deftly, to invent and design, one must have in a considerable degree the second type of intelligence; in order to be a successful salesman or a social leader one must possess superiority in the third type of intelligence.

"Not only are there three main types of innate intelligences, but within these main types there are subdivisions. An intelligence test that surveys a person's general intelligence does not indicate in particular the various aspects of this intelligence. To quote Whipple: 'Take, for instance, the testing of mentality of a gifted child, a Winifred Stoner or a William James Sidis. To discover by simply testing that such a child has an I. Q. of a given amount is interesting, but it fails to get us anywhere in

* Thorndike, E. L., *Individuality*. By permission of Houghton Mifflin Company.

our real inquiry as to just which ones of the various mental functions are possessed of the extraordinary heightened efficiency. Is it memory span or capacity for concentrated attention or ability to handle symbols or apprehension of abstract relations or acute perceptive capacity or lively imagination or originality or breadth of associative tendencies or speed of learning or what that demarcates such a child from other children? What about his special abilities: does his musical, mechanical, arithmetical, linguistic, dramatic, executive, poetic, artistic and so forth ability exhibit the same unusual development or not? These questions compel us to plan out an elaborate program of mental testing and to carry this forward on the one individual until we can plot for him a comprehensive "psychogram" or "psychological profile." "*

"Thus the question as to whether there is a general (innate) intelligence or various kinds of general intelligences, more or less closely related, in the same individual is still a matter of controversy. The writer, personally, is inclined to the second view. He is led to assume that there are various inborn abilities that are general in their character in the sense that they appear in many life situations and in a somewhat close agreement in a single individual and that at the same time there are abilities of a very specific character that are not closely related to other abilities. Generally speaking, a pupil who has the capacity to do good work in arithmetic or algebra is likely to stand well in history or geography or general science; he may do good work in the manual training shop, though this is by no means certain. It would not be safe to predict confidently in regard to his ability to sing or act, to paint or to dance, and it is quite possible that, while he might stand at the head of his class in high school or college, he would have little or no native ability as a newspaper reporter or a salesman. After all, to the practical schoolman it makes very little difference whether general intelligence is a central factor or a bundle of different abilities related positively; the child cannot be treated as a unit—he must be discovered in his various tendencies and abilities and if we wish to know him as he really is, we must be able to work out the 'psychogram' which Professor Whipple has mentioned."

* Whipple, G. H., Bulletin of the Extension Division of Indiana University, Fifth Conference on Educational Measurements. By permission.

Intelligence as Ability to Learn. "Up to this point our discussion has concerned itself with the significance of the term 'general' as descriptive of intelligence. We have seen that it means an inborn capacity or group of capacities more or less closely related. All psychologists agree that it refers to something innate, something that cannot be acquired or learned. Some psychologists consider it to be a single, unitary, central trait, others a group of traits that can be conveniently classified together and which show certain relationships and correspondences. It is now left for us to consider what the second part of the term 'general intelligence' signifies to psychologists. Here again we find a reasonable, but not a complete agreement.

"Recently a group of fourteen psychologists, authorities on mental testing, contributed to a symposium on the subject of 'Intelligence and Its Measurement' in the *Journal of Educational Psychology.* In this symposium they gave their views as to the nature of general intelligence. Some took the ground that the term intelligence could not be adequately defined or described in the present state of our knowledge; others gave very broad definitions, such as the 'power of good responses from the point of view of truth or fact,' or 'the ability of the individual to adapt himself adequately to relatively new situations in life.' Some emphasized the rational element as the essential one, considering intelligence as the ability 'to carry on abstract thinking.' This latter definition doubtless concerns the highest level of intelligence, and is one very essential aspect of it, but an individual may have little ability to deal with abstract ideas or to reason and may still possess a modicum of intelligence. Indeed, the intelligence tests so far devised give only a small part of their attention to the testing of reasoning abilities, and devote a much larger share to more simple intellectual processes. Buckingham seems to express the matter of intelligence tests and the nature of intelligence in a helpful way when he says that, whatever our views may be in regard to the nature of intelligence in the abstract, 'we are justified, from an educational point of view, in regarding it as ability to learn, and as measured to the extent to which learning has taken place or may take place.' " *

* Buckingham, B. R., *Journal of Educational Psychology,* Vol. XII, No. 5, p. 273. By permission.

Ability to Pass Tests Based on Previous Learning. "An inspection of the various intelligence tests now in use clearly shows that psychologists have accepted this definition practically, if not theoretically. Intelligence tests are by no means confined to problem-solving, even in its simplest forms. They determine an individual's intelligence largely in terms of what he has learned, thus obtaining a measure of his ability to continue learning. Vocabulary tests, range of information tests, same-and-opposites tests, tests of fundamental operations in arithmetic (one of the most widely used) and the like, demand little that is novel, little that tests rational powers. If an individual has sufficient knowledge and skill he can pass these tests. They measure intelligence only on the assumption that they test ability to learn by discovering what has already been learned. Even those tests that involve ingenuity, deliberation, and choice with words or things are based on elements that show what a person has already acquired. An example of this fact may be shown by the following extract from a test:

" 'Below are five words, four of which are related according to some principle. One word is not so related. Cross out the unrelated word: physics, chemistry, geology, history, biology.'

"Now it is quite obvious that a successful passing of such a test is in part dependent on an ability to reason, to classify, to meet intelligently a new situation, or on some other similar mental activity of a fair degree of complexity; but also a large, perhaps the greater part is dependent on a knowledge of words and their significance in more or less detail. This knowledge is based on previous learning. It is clear, then, that a considerable part of intelligence testing is dependent on what has been learned; further, it should be remembered that the ability to learn is very closely related to the capacity to meet new situations intelligently, to reason, to abstract, etc. Therefore, to identify general intelligence with native learning ability is, both theoretically and practically, justifiable. We shall not be far from the truth when we define general intelligence as a group of innate capacities by virtue of which the individual is capable of learning in a greater or less degree in terms of the amount of these innate capacities with which he is endowed.

"*How Can General Intelligence Be Measured?* General intelligence is an inborn capacity. It does not manifest itself, how-

ever, except through learning. If an individual were born with a high capacity to become intelligent, but had no opportunity to learn, he would possess no intelligence. Intelligence must be acquired. Only the capacity is inborn. There has been much argument in recent years as to whether nature (inherited capacity) or nurture (training or the environment) is the more important. The whole discussion is likely to be beside the point and quite misleading unless care is taken to define exactly the position taken by those who debate the question. It is quite evident that a feeble-minded child can never become highly intelligent, never mind how favorable his environment, how skilled and patient his teachers. His innate endowment will not permit him to go beyond a certain level of attainment. Water will not rise above its level. On the other hand, the greatest potential intelligence will never become highly intelligent in an environment that affords scant opportunity to learn. The brightest European child reared from birth by a group of African Pygmies would appear as a moron or worse if later transported to a highly civilized and cultured environment. Whatever the native mentality of a deaf-mute, that individual must actually grow up as feeble-minded unless special methods of instruction are employed to reach his native ability and develop it. The truth of the matter is that when an environment is practically the same for a group of individuals, then the great differences that are found among these individuals are due to differences of native ability. Specifically, if forty children in the fifth grade of elementary school show varying degrees of attainment in their school work, it is probably true that these differences are to be explained to a considerable extent as arising from inborn differences in mental capacities. The justification for the truth of this explanation lies in the fact that all of these children had similar opportunities and similar incentives to learn. The environment in which they had been reared, while not identical for all, has not varied substantially from child to child; at any rate they have had about the same schooling. One factor (the environment) in the acquisition of intelligence has been practically constant; hence differences in acquired intelligence must be largely due to the other factor (innate capacity to learn). Nature is more important than nurture in explaining individual differences in acquired intelligence, when the nurture has been

similar for the group concerned. On the other hand, it would be equally true that nurture would be more important than nature in explaining individual differences if the native equipment of a group were substantially the same and the environment markedly different."

Intelligence Testing Assumes Common Experiences. "The foregoing consideration explains the feasibility of devising tests to measure general intelligence. At first thought, it may seem impossible to determine the amount and nature of an innate capacity or group of capacities that manifest themselves only through learning. These capacities can be measured only indirectly through what has been acquired, never in their native purity. However, they can be indirectly measured successfully by measuring the acquired capacities in a group with substantially the same experience. We never measure inborn intelligence; we always measure acquired intelligence, but we infer from differences in acquired intelligence, differences in native endowment when we compare individuals in a group who have had common experiences and note the differences in the attainment of these individuals."

Binet Test Assumes This Principle. "Hence it follows that an intelligence test, to be valid, must be composed of elements appealing to the common interest and within the common experiences of the group tested. All successful intelligence tests have implicitly or clearly recognized this principle in their construction. As a case in point let us consider the Binet tests as originally devised by their author. They show on examination the fact that their separate tests were arranged on the basis of the common experiences of the children of varying ages. Children failing to pass tests for their particular age satisfactorily were classed as subnormal because they were below the reasonable attainment of their group. In no case were tests employed that were based on peculiar conditions or unusual opportunities for learning. For example, a child of three is asked to point to his eyes, his nose, his mouth, to tell what he sees in a simple picture, etc.; a child of four to identify a key, a penny, and a knife. An older child is asked to count and make change, to give a rough definition of certain simple objects, to execute brief commands, to estimate weights, to give explanations and reasons, to make aesthetic comparisons, and so on. The validity of this

mental examination is definitely dependent on the extent to which the children examined have had previous knowledge of the items in which they are tested. Clearly, a child of three, however bright, could not point to his nose unless he had previously learned about this part of his face. To count pennies, to make change, to give sensible answers and explanations, these attainments are conditioned on the opportunities the children have had to learn about pennies, actual practice in counting and making change, knowledge of the words which they are to define, etc. Binet found, for example, that the average child of seven years could do certain things and answer certain questions. If a child of seven falls far below the average in his ability to respond to the tests, this is not because of lack of opportunities to learn, but because of definite inability to learn. Such a child is feeble-minded if this inability is pronounced."

Common Interests Also Assumed. "It cannot be too strongly emphasized that no test to determine intelligence is valid unless the individual tested has had a reasonable opportunity to learn about the various elements involved in the test and has also been interested in learning. Some errors have already been made and still more are likely to be made in drawing conclusions as to the absolute or relative intelligence of individuals in a group or in various groups when the experiences and interests of members of the group or groups have been to any considerable extent different. A few specific examples will make this important point clear. It is a striking fact that the Army Alpha Tests, which in the past few years have been given extensively in colleges, normal schools, and high schools, show in practically every instance higher average scores for men and boys than they do for women and girls. The conclusion might be reached that the intelligence of men on the whole is somewhat superior to that of women. That such a conclusion is not justified is at once seen when the Alpha Tests are examined. These tests were devised to measure the intelligence of soldiers. They included materials which on the whole would be somewhat more familiar to men than to women, because the interests of the sexes are not by any means the same. It is the interest here in learning rather than the actual opportunity to learn that determines whether the test is equally fair to both sexes.

"Another and more emphatic instance in point will show

even more clearly how the matter of interest may determine whether materials included in a mental test are equally fair for all tested. A few years ago the writer gave the Stenquist mechanical ingenuity tests to two high-school groups, one of boys and the other of girls. The boys scored decidedly higher than did the girls. The difference was impressive, and from it might have been concluded that the innate mechanical intelligence of the boys was vastly superior to that of the girls. The facts, however, warrant no such conclusion. Girls traditionally are not interested in things mechanical, and not being interested in them, they do not learn about them. They may or may not have equal innate mechanical intelligence. The Stenquist tests could throw no light on this problem unless they were given to groups of boys and girls all of whom had the same opportunities and incentives to learn about mechanical facts and principles."

Scores Dependent on Knowledge of English. "As has been said, opportunity to learn as well as interest in learning is a determining factor in devising and using mental tests. As an illustration of this may be cited results obtained in giving the Otis Intelligence Tests to the children of the public schools in Brookline, Massachusetts, and in Cincinnati, Ohio. In the former city the tests were given under the direction of the writer; in the latter, by Warren W. Coxe. In Brookline the average scores were much larger than in Cincinnati. The children of Brookline were on the whole a clearly superior group, according to the published Otis norms, while the children of Cincinnati were somewhat inferior. An average Brookline child of twelve would have, according to the results of these tests, a mental age about two years in advance of the average Cincinnati child. Are we to conclude, then, that the Cincinnati children are really inferior in innate intelligence to the Brookline children? I am inclined to think not. The great differences in the scores I attribute to differences in opportunities to learn words and their meanings. Examination of the Otis tests, and other similar tests, will show that success in passing these tests is conditioned largely on extent and accuracy of vocabulary and on verbal ingenuity. In no single element entering into school attainment do children vary so much as in the knowledge of words and the ability to use words. Much of this knowledge and skill is determined by the home environment. Brookline is, on the whole, a center of culture

where the children acquire at home an ability to use English in a superior degree. The same is not so conspicuously true in Cincinnati.

"That this explanation is not altogether fanciful is shown by the following facts: In Brookline there was a considerable difference in the median scores, as well as the maximum scores, for the children of the 'better' and the 'poorer' localities. These differences were marked in the case of most of the verbal tests; they were not found to exist when the arithmetic tests were examined. Clearly, the differences were differences in verbal ability, not innate intelligence.

"Further corroborative evidence that this explanation is at least in part correct is indicated by the circumstances that a number of students in Brown University either foreign born or of foreign extraction have received low scores on their mental tests but have done good college work. On investigating these individual cases, I have found that the low psychological scores are to be explained by the fact that these students have not the same familiarity and facility with the English language as those who have been reared in a more favorable environment. It is not their innate intelligence that is inferior, but their mastery of the vernacular.

"Carrying this investigation somewhat further, I have collected data to show that in the City of Providence the Italian children receive scores in the National Intelligence Tests (largely verbal) on the average lower than those of the children reared in an English speaking environment. The Italian children, therefore, appear to be as a class of less intelligence than the children of native parentage. A more careful examination of these different groups reveals the fact that the National Intelligence Tests tend to underrate the real mentality of the Italian children. They score lower than the English groups because of less familiarity with English. It seems probable that all mental tests that are largely linguistic will be unfair to those persons whose training in English either at home or in the school has been inferior. It is only when individuals tested have had common opportunities to learn the vernacular that real differences in intelligence can be surely inferred from the scores secured. It must be kept in mind that no general tests for general intelligence have yet been devised. Tests are valid only within a

group who have had identical or very similar opportunities for gaining familiarity with the materials of the test, and who have not only the same opportunity to learn, but the same desire to learn."

Administration of Tests Must Be Uniform. "Further, the validity of tests is based not only on the considerations pointed out above. It is likewise dependent on the care, accuracy, and consistency of administering and scoring. Tests poorly and carelessly given and scored may give one result; tests carefully and accurately given and scored quite another. Indeed, Coxe in attempting to explain the great difference between the Brookline and the Cincinnati scores says: 'The only possible explanation that occurs to us is in the method of giving and scoring.' He then goes on to point out that the tests in Cincinnati were given with the greatest care by himself and one assistant. However, this explanation does not seem to account for the differences in this particular case, since the Brookline tests were administered only after very careful instruction of the teachers in the method of giving the tests, and since the results showed consistency among themselves. If they had been given carelessly and in various ways, there would have been no general tendency in one specific direction, as was the case with the Brookline scores.

"However, that the significance of tests may be greatly impaired by lack of uniformity and care in administering and scoring seems to be shown by the results that Book obtained from a mental test given to the seniors in the high schools of Indiana. He sent to the various high-school principals of the state copies of the Indiana University Intelligence Scale, Schedule D (the Pressey Tests), through the offices of the state high-school inspector. With the test blanks were sent manuals of instruction to teachers and explicit directions for giving the tests. The actual giving of the tests was intrusted to a large number of individuals, many of whom had little or no knowledge of mental testing and few, if any, of whom had had any definite training in giving the tests. Under such conditions there must have been considerable variation in the manner in which the tests were administered. The result showed a low positive correlation between the scores in the mental tests and the previous school records of the seniors tested, as well as other

facts that indicated that the relation between intelligence and school success was not so pronounced as is probably the case. Had these tests been more carefully and uniformly administered, it is certain that the findings would have been more definite and of greater practical value.

"*Summary.* It may be seen from the foregoing discussion that in giving mental tests the following considerations should be definitely kept in mind:

"1. Are the tests so devised as to be suited to the group tested? Particularly, do they contain materials with which all tested have had similar incentives and opportunities to gain familiarity?

"2. Can comparisons safely be made between the group tested and other groups that have already been tested or are later to be tested? In other words, can general norms be relied on, or is it necessary to establish a norm for the particular group tested? The writer's opinion is that in the case of the great majority of the mental tests now on the market, little of definite value can be obtained by the use of the general norms already published.

"3. Are the tests administered and scored in a careful and uniform manner? Tests are much more satisfactorily administered if given by one individual trained for the work. When the tests are administered by a number of individuals there should be ample discussion of the nature and significance of the tests and practice in their use before they are given."

[Colvin, S. S., "Principles Underlying the Construction and Use of Intelligence Tests," in *Twenty-first Year-Book*, National Society for the Study of Education (Public School Publishing Co., Bloomington, Illinois 1922), pp. 11–25. By permission.]

The criterion for determining the validity of intelligence tests is whether the scores in the tests correlate with school success. It may be agreed that such success is not the only mark of intelligence, and that, therefore, the intelligence measured by the tests is not general intelligence but a sort of "academic" intelligence. The plea for the acknowledgment of this kind of limitation to these tests, made by Professor Dearborn, whose views are the result of much first-hand knowledge of the subject, should be carefully considered.

4. INTELLIGENCE AND ACHIEVEMENT IN SCHOOL

Limitations of Individual, Family, and Race. "The wave of intelligence testing which has swept over American schools has carried with it some debris: among other things the much-discussed notion of a fixed intellectual endowment, with which a child is born, which neither he, his parents, nor his teachers can by taking thought alter, and which the intelligence tests are designed to measure. The considerations presented in the preceding chapters have, I trust, made clear that, on the contrary, what the intelligence tests measure is definitely affected for better or worse, that it is increased or decreased, by what the home and the school, or the parent and the teacher, do for their children and pupils.

"The cultural anthropologists and psychologists, as contrasted with those who believe in the preponderating influence of that which is instinctive or inherited in shaping the destinies of man, are insisting with renewed vigor, regarding this recent formulation of the old problem of nature versus nurture, that the intelligence tester is overemphasizing nature. Professor Boaz has recently pointed out that, although there are evidently marked anatomical differences between men, different individuals may become adjusted to the same demands. 'The healthy individual without harm to his body, may at one time be a vegetarian and at another time may live on an exclusive meat diet. He may live a lazy life at the level of the seas, or subject himself to strenuous activity in high altitudes. There are limits to adaptability that depend on the soundness of the organism, but within wide limits of external conditions, an optimum of efficiency may be maintained.' * There is a 'margin of safety which exists for all organisms.' So, given the environmental demand, or, as the psychologists like to say, 'stimulus,' the same individual, the same family strain, and the same race may show a wide range of intellectual functioning. With such considerations in mind, we may well be cautious in prophesying the limits of individual, family, or race achievement. Yet this is in fact what the intelligence tester has been attempting to do."

* Boaz, Franz, "Growth and Development, Bodily and Mental, as Determined by Heredity and Social Environment," *The Child, the Clinic and the Court*, pub. by The New Republic Inc. (1925).

"*School Progress and the Intelligence Quotient.* Intelligence tests are now being used to a certain extent in school and college to set standards for individual and group accomplishment. We are told that a child with an intelligence quotient of 70 cannot expect to complete the work of more than the fourth or fifth school grade, however long he may stay in school; that in order to finish the eight grades with comfort, he must have an intelligence quotient of 100; that to enter high school he should be above the average of his age in intelligence, and to graduate from high school, without undue exertions, he must have at least an I.Q. of 110. If the student thinks of entering college, he should first ascertain that he has an I.Q. of 115 or better, or he may be in danger of falling by the way-side, and if he has any desire for a *cum laude* to say nothing of the *magna* and *summa* or Phi Beta Kappa he is, if without an I.Q. of 120, doomed either to disappointment or to hard labor. Had the famous Indian student whose visiting card bore the inscription 'Failed A.B.' also announced in another corner of his card a low I.Q., his failure to receive the bachelor's degree would seem to the intelligence tester completely accounted for.

"*Freedom of the Intellect.* Of course, these statements are of what is said to hold on the average, and exceptions are noted, but with the expression of such finality for the average even, it is small wonder that this attempt at the standardization of the intellect has been regarded as but another consequence of a mechanistic and materialistic age. As men have fought to preserve their notions of the freedom of the will, so now the battle rages for the freedom of the intellect. The really important limitations to the freedom of the will have been found to be those which are self-imposed or imposed by society. But, in the case of the intellect, in addition to the limitations for which the individual may alone have himself to blame, and to those set by the family, the school, the occupation, and by the more general cultural environment, there are limitations which appear intrinsic or native. Psychologists have at times in their discussions assumed that the individual's limitations were due solely to intellectual endowment which he inherits, and that the intelligence test measures solely this hereditary endowment, or native intelligence. It is to this unwarranted assumption that the apparent finality of the preceding statements is due. But no one

has succeeded in separating these factors, and the intelligence test measures the composite result. Some of these factors may be under control in a given case and others may not. Even such a conservative statement as the following from a recent book errs in regarding endowment as the one factor isolated by the tests.

"'Either everybody is born with the same intellectual potentialities or not. Either everybody is equally endowed or differently endowed. . . . Those of us who believe in psychological tests feel that, however crude and inadequate our present methods may be, we have at least at our command a means of discovering the grosser differences in intellectual endowment in early childhood.' *

"But the shoe fits quite as well on the other foot and we may then say that what the intelligence test does is to anticipate or foresee what the school and society are going to do to the individual in the course of time. So long as the school and society remain as they are, this previsioning is possible in a great many cases—and is very useful. As we have seen, the teacher's judgments, marks, and examination grades also share in this distinction and service. The tests and the teachers predict what the individual is likely to learn from what he has already learned. But in how far the previous learning, which is the basis of prediction, is due to faulty and limiting habit and in how far to limited endowment is a matter of conjecture. Here no more than elsewhere can we separate nature from nurture; intellect from culture; neither the body nor the mind develops *in vacuo*.

"If we do not like the prophecy of the tests, we may try to change such conditions as are under our control; or we may change the tests. The latter alternative is not altogether bizarre. Since schooling is not all of education, non-scholastic tests may discover other aptitudes, and, eventually, the schooling may be changed to allow of their development. Indeed, this appears to be one of the great opportunities of the intelligence tests. Other means, such as teachers' marks—and especially the average scores of a lot of subject-matter tests—will predict quite as well as the present intelligence test how the individual is coming out in school. If the intelligence test can discover other abilities

* Irwin, E. A. and Marks, L. A., *Fitting the School to the Child.* (The Macmillan Co., N. Y., 1924.)

than those required to master the school curriculum, a different prognosis may be made for the individual, when opportunities are given for the development of these latter abilities.

"*Intelligence of the School Dullard.* Neither the school nor the tests at present gauge all the intellectual powers of a man. We need but recall some of the names of illustrious men and women who were either school failures or in whom the contrast between the accomplishments in life and their attainments in school is extraordinary. Linnaeus, Pasteur, Ruskin, Charles Darwin, Sir Isaac Newton, Alexander von Humboldt, Heine, George Eliot, Hegel, Hume, Spencer, Liebig are among those who might be cited. In some such instances, the art of the biographer tempts him to too great contrasts and exaggeration, but in the examples cited the evidence is sufficiently objective.

"Linnaeus was regarded by the director of the German Gymnasium in which he studied as unfit for a profession and was advised to take up a trade. He was sent to the university with this dubious recommendation: 'Youth at school may be compared with shrubs in a garden, which will sometimes, though rarely, elude all the care of the gardener, but if transplanted into a different soil may become fruitful trees. With this view, therefore, and no other, the bearer is sent to the university, where it is possible that he may meet with a climate propitious to his progress.' *

"Charles Darwin says in his autobiography: 'During my whole life I have been singularly incapable of mastering any language. . . . When I left the school, I was for my age neither high nor low, and I believe that I was considered by all my masters and by my father as a very ordinary boy, rather below the common standard in intellect.' †

"Herbert Spencer believed his memory, 'in respect both of quickness and permanence,' was below par. He developed an antagonism to rote memorizing which may explain his difficulty in some of his school subjects. 'A related fact,' he adds, 'is that throughout boyhood, as in after life, I could not bear prolonged reading. . . . While, however, averse to lesson-learning

* Swift, E. J., *The Mind in the Making a Study in Mental Development.* By permission of Chas. Scribner's Sons.

† Darwin, F., *Life and Letters of Charles Darwin.* By permission of D. Appleton & Company.

and the acquisition of knowledge after the ordinary routine method, I was not slow in miscellaneous acquisition.'

"There are other examples where an even more specialized disability, such as we shall be especially interested to examine in the next chapter, gives the appearance, until it is compensated for by other learning, of a general deficiency. Liebig believed that one reason for his very poor showing in school was due to a defect in his auditory memory, as a result of which he could retain little of what he heard. The customary emphasis upon oral instruction in the early forms or grades of school may, as we shall see, produce in such cases a general retardation in learning which seems quite out of proportion to the initial cause.

"We recognize, of course, that most school failures and most pupils of low I.Q., as well as many who do but passably well in school and in the tests, may have general intellectual shortcomings. In others, there may be special disabilities which simulate for a time a general deficiency. In still other cases, the shortcomings appear confined to the somewhat narrow range of abilities which the present tests and the school alike require. The latter individuals, and this is a point stressed in the preceding chapter, which we would now reiterate, may be possessed of other intellectual abilities quite as significant as the abilities of which the tests and the schools are more particularly cognizant.

"*The Problem of Retardation in School.* One other argument for the preponderating influence of endowment or intrinsic factors, may be mentioned The American school world was aroused at the beginning of this century by studies which showed the great numbers of retarded pupils in school. Ayres in his *Laggards in Our Schools* listed as the causes of retardation: sickness, physical defects, irregular attendance, poor home environment, difficulty with the English language, too rigid promotion scheme, and lack of application. He did not mention what is now said to be the chief factor—lack of intelligence. In communities where many of the conditions named by Ayres have been greatly improved, where visual and auditory defects have been corrected, tonsils and adenoids removed, teeth filled, where there is less sickness from contagious and other diseases, where school attendance is much more regular, the teaching and facilities of instruction bettered, and the standard of life in the

community greatly improved—in these communities there is still as much retardation in school as before. Therefore, the argument runs, the real cause must be due to something else which has not been remedied, and the only thing left that we can think of is an inborn lack of intelligence, which, since the amount of intelligence is fixed at birth, we cannot alter. But this is not quite the whole story. As a result of the physical, scholastic, and social betterments, improvement in intelligence may really have been brought about, but with the improvement, educational standards have been also gradually advanced.

"Although everybody has improved and the average attainment has advanced, relatively to these new and higher standards set for achievement there are just as many laggards as there were before. There would be much justification for saying that the problem of school retardation is one of standards rather than of intelligence.

Classifying Pupils by Intelligence Tests. "Whether or not all individuals are alike in endowment at conception (and the writer does not believe they are, but belief is quite a different thing from proof), it appears certain that they are not equal at birth. It is also evident that they are not equal in attainment when they enter school at the age of five or six. Furthermore, the range of capacities or the attainments of pupils is so great in the ordinary first grade class that it is not possible to suit instruction to all. The promise of the intelligence test is that, by recognizing these differences earlier and more unerringly than teachers or the school as an organization has been accustomed to do, it is possible to classify pupils at the start into more homogeneous groups, a thing which the school eventually does by retarding some of its pupils and eliminating others.

"In the country at large, it is said that a little over a third of the pupils who enter school reach the high school, and that only between a fifth and a tenth graduate. It may now be said that the major reasons for leaving school are either inferior mental ability, or the lack of the particular kinds of abilities or attainments which the schools require. The present intelligence tests are so constituted that they, also, require for their passing chiefly these scholastic abilities. The desirability of the school and the tests recognizing the possibility of usefulness in the abilities of the eighty or ninety per cent of the population

who leave school is therefore again reinforced by a consideration of the problem of elimination from school."

[Dearborn, W. F., *Intelligence Tests* (Houghton Mifflin Company, Boston, 1928), pp. 134–143. By permission.]

5. EFFECT OF ENVIRONMENT ON THE INTELLIGENCE QUOTIENT

Gordon's Study of Canal-Boat Children. "A most ingenious and convincing inquiry into the effect of education on intelligence test-scores was reported in 1923, by Hugh Gordon, an English school inspector. This monograph, like that of Mr. Burt, has received scant notice from American determinists. Burt has inferred from his findings that 'mere growth' unaccompanied by school opportunities produced relatively little mental development. Gordon conceived the idea of comparing apparently low-grade intelligence-groups who had had little or no schooling with a truly low-grade intelligence group that had had school advantages. The former groups comprised physically defective children, canal-boat children, and gypsy children; the latter was made up of backward children enrolled in ordinary elementary schools. The Stanford Revision of the Binet tests was the basis of the intelligence examinations, and the intelligence quotients (termed 'intelligence-ratios' by both Burt and Gordon) were determined in the usual way. Educational quotients (or 'ratios') were also computed on the basis of achievement tests. Correlations of various types were made, the most significant, of course, being those between intelligence and school attendance. An important purpose of the investigation was to gain further light on the discrepancy between Burt's conclusions regarding the influence of schooling on the intelligence-scores and the 'opinion held by many authorities' (we might add, by practically all of the leading American students of the problem) which Gordon exemplifies by the following quotation from Professor Terman's book, *The Intelligence of School Children:* *

" ' "That the lack of schooling does not prevent a subject

* Terman, L. M., *The Intelligence of School Children.* By permission of Houghton Mifflin Company.

from earning an average or superior score in the test is shown by the cases of S. S. and Gypsy Mary.'' '

''From his study of the physically defective children Gordon concluded that the low mental age represented by these children could be attributed neither to heredity nor to home environment, for both of these factors were not essentially different for the physically defective children and for the backward children attending an ordinary elementary school. Nor was there any evidence that the low mental age was due to the physical defects as a direct cause. By comparing the correlations between school-attendance, mental age, and educational age, however, it was apparent that the relatively brief time spent in school by most of the children (because of their physical defects) would clearly account for the low average mental age. Gordon closes this section of his report as follows:

'' 'The result of this investigation clearly indicates, so far as these tests are concerned, that the tests (''intelligence'') are tests of school attainments; that, in fact, scholastic tests properly standardized for age do yield results that are for all practical purposes of equal value for determining so-called ''intelligence.'' The lack of schooling has, in fact, affected equally both scholastic attainments and ''intelligence'' (as found by test). That such scholastic attainments are in part due to real intelligence is hardly necessary to add.'

''The investigations on the canal-boat children furnished even more impressive evidence in support of the same conclusion. These children are almost entirely cut off not only from schools but from practically all contacts except with members of their own families. The situation is described in an official report by the Ministry of Health, which Gordon quotes:

'' ' ''. . . the evidence is overwhelming and practically unanimous that under present circumstances Canal Boat Children are scandalously under-educated. When their manner of life is considered, it is not surprising; their only opportunity for schooling occurs when the boats are tied up for loading or discharging, and the fact that many of the adult boat population are themselves unable to read or write has a tendency to make them lax in seeing that their children take full advantage of their opportunities . . .'' '

''Concerning the social isolation of the children Gordon adds:

" 'When the boats remain in a town for loading and unloading, the children do not appear to mix readily with other children; they attend places of entertainment, such as cinemas, etc., and have money to spend. Many of the children are well dressed, clean and appear fairly intelligent, although some of the older ones are undoubtedly very dull. The majority were found to be anxious to talk, but it was often difficult to understand what they said owing to their indistinct articulation and their use of unrecognizable words . . .'

"And he adds by the way of summary:

" 'To sum up, these children in respect to health, cleanliness, morality, feeding, etc., are fully equal, if not superior, to town dwellers of a similar character. That they are not mentally defective, as is generally understood by that term, is shown by the life and wages of their parents, who in many cases have had no education and can neither read nor write. Their intellectual life, on the other hand, is of a most meager description, owing to their lack of education and also owing to their social isolation.' "

Effect of Lack of Education on Intelligence. "When the intelligence-tests were applied to these children, the average intelligence quotient was found to be very low (69.6), or only a little higher than the average rating of children in schools for true mental defectives. The most significant finding, however, was that the intelligence-quotients of children from the same families decreased steadily from the youngest (of those tested) to the oldest. In other words, the youngest children tested (from four to six years old) compared favorably with children of the same pre-school age living under normal conditions, the average intelligence-quotient being 90 for this group, and the deviation from the normal (100) being perhaps explicable in terms of the social isolation already referred to. The oldest children tested (twelve to twenty-two years), however, had an average intelligence-quotient of only 60, or so far below average children of the same age living under normal conditions as to stamp them as distinctly subnormal. Inasmuch as these comparisons hold within families the conclusion is inescapable that the lack of schooling is the causal factor in producing the low 'intelligence.' "

Gordon's Interpretation. "Gordon's interpretation of his findings is illuminating:

" 'The fact that there is a marked decrease in "intelligence" with an increase of age, and that this is especially noticeable among children of the same family suggests very convincingly that the low average "intelligence" of these children is not due to heredity. It may be due to (social) environment, or to the lack of schooling, or to both combined. But as it has been shown that the correlation between the results of the mental and scholastic tests is very high, and further that the average ratios (quotients) for these two sets of tests are approximately the same, it may be assumed with some reasonableness that the lack of schooling has affected both "mental" and scholastic attainments to the same extent. . . . It is clear, however, that for the very young children there cannot be any educational tests, as such children have, as a rule, no so-called scholastic attainments, and for this reason the "mental" tests are necessarily not of the same character as those for the older children, and in consequence the children tested normally. Without the mental effort or mental exercises associated with schooling it would appear that there has been very little mental development on the intellectual side. How far there has been a similar lack of development among these children in connection with problems touching their own special environment, it is difficult to say and, without tests especially devised and standardized for children in such surroundings, impossible to measure.'

Study of Gypsy Children. "The results of the tests applied to gypsy children clinch in a very convincing way the conclusions drawn from the studies of the physically defective children and the canal-boat children. The conditions under which these children live are described by Gordon as follows:

" 'In the case of the gypsy children also there has been a serious lack of schooling, and many attempts have been made to provide them with more education, but the question is surrounded by many and great difficulties due to the nomad habits of their parents. . . . Gypsies seldom stay in one place for any considerable time, except perhaps during the winter months; at other times they are moving from place to place, fruit-picking and hopping. . . . The attendance of the children at school is therefore very irregular and much broken up. . . .

" 'Gypsies live mostly in a decrepit assembly of caravans and "shacks" made of odds and ends of wood and tarpaulins; the children sleep in "queer arrangements" on the ground. There are, as a rule, no proper water supplies or sanitary conveniences. . . .

" 'The children are "dirty and insufficiently clothed"; they wear neither shoes nor stockings at home; they have good boots but take them off outside the school premises. The insufficiency of clothing is seldom due to poverty, as gypsies always appear to have money for bargaining and are prompt in the payment of fines. . . .

" 'There is little crime among the gypsies, and no real evidence of intimidation. . . . "But they have rather primitive views as to the rights of property, especially in respect to what grows or moves upon the earth in a more or less wild state, and stick-cutting and poaching and petty pilfering are common enough." . . . .

" 'As a rule, the children are absent from school from June to the middle of October; they only seek admission when caught, or when they hope to get assistance in meals or clothing. . . .

" 'As to their conduct in school, teachers report it to be quite satisfactory, and that they give little or no trouble in obedience or behavior after they have been taught "the essentials of truth and language." . . .

" 'It seems to be the general opinion of teachers that little permanent improvement can be effected in the education of these children unless some sort of continuity of schooling can be enforced. . . .

" 'Compared with the Canal Boat children, these gypsies appeared to be very much more alert and intelligent. Their social environment is very different from that of the Canal Boat Children; they mix freely with the other gypsy children and have some intercourse with the outside world in their selling and buying.'

"The application of the intelligence-tests to eighty-two gypsy children disclosed an average intelligence-quotient of 74.9, which is between the average of the physically defective children and the average of the canal-boat children. Like the latter, the gypsies revealed a decreasing quotient from the younger to the older age-groups. This held within the several families as in the case

of the canal-boat children, and the fact is advanced by Gordon 'to confirm the conclusions formed in the previous investigations.' Of prime importance are his general comments on all three studies:

" 'The far more important question suggested by these results is whether there is any mental development apart from mental effort and such mental exercises as are generally associated with school life. The answer to this question probably depends upon the social environment of the children. In a good social environment a child's development would not be so dependent on the effects of schooling as in a poor social environment in which there was little or no intellectual life. Further, it would seem that too long delay in a beginning of school life has had a very injurious effect on such children as have been tested, that, in fact, it is almost impossible to make up for such delay. As to whether these children might do better in "performance" and other tests is a matter of much interest. It is my impression that the gypsies might do better, but not the Canal Boat children. An opinion on such a matter without further evidence is, however, of little value.' "

[Bagley, W. C., *Determinism in Education* (Warwick & York, Baltimore, 1925), pp. 138–144. By permission.]

QUESTIONS

1. What is the most commonly accepted definition of intelligence?
2. Compare the various definitions of intelligence. How do they differ? Are they contradictory?
3. Are people who succeed in life apt to be conspicuous for brightness at an early age? What specific cases can you cite besides those mentioned in the text?
4. What are the various causes for the varying degrees of success of different people?
5. What is Thorndike's view of the nature of general intelligence? What are the three main types of intelligence according to Thorndike?
6. What is a psychogram? What is its purpose?
7. What is the fundamental assumption of intelligence testing?
8. What is meant by the statement that we never measure intelligence directly?
9. Why do males make higher scores in the Army Alpha tests than females?
10. If a child is brought up in a non-English speaking home, is it likely to affect his score on an intelligence test? Why?
11. Is school progress determined by the I. Q.?
12. Outline Bagley's argument against the "determinists."

CHAPTER VIII

MENTAL DEVELOPMENT

There are two different points of view concerning the mental changes which take place as a result of increasing age. According to one view the mental life of human beings is marked off into well-defined stages. There are some writers who believe that the mental characteristics of the young are markedly different from stage to stage of their growth. On the other hand, some observers of child development believe that such changes as take place on account of increased maturity are so gradual that it is impossible to find enough distinguishing characteristics of any particular period to warrant the belief in marked stages of growth.

Stanley Hall was one of the chief supporters of the first doctrine of mental development. Basing his argument on a modification of the biological doctrine of recapitulation, Hall made a sharp distinction between the mental characteristics of the adolescent youth and those of the same youth in the period preceding adolescence. His doctrine as he himself expounds it follows.

1. YOUTH

The Years from Eight to Twelve. "The years from about eight to twelve constitute a unique period of human life. The acute stage of teething is passing, the brain has acquired nearly its adult size and weight, health is almost at its best, activity is greater and more varied than it ever was before or ever will be again, and there is peculiar endurance, vitality, and resistance to fatigue. The child develops a life of its own outside the home circle, and its natural interests are never so independent of adult influence. Perception is very acute, and there is great immunity to exposure, danger, accident, as well as to temptation. Reason, true morality, religion, sympathy, love, and esthetic enjoyment are but very slightly developed.

"Everything, in short, suggests that this period may represent in the individual what was once for a very protracted and rela-

tively stationary period an age of maturity in the remote ancestors of our race, when the young of our species, who were perhaps pygmoid, shifted for themselves independently of further parental aid. The qualities developed during pre-adolescence are, in the evolutionary history of the race, far older than hereditary traits of body and mind which develop later and which may be compared to a new and higher story built upon our primal nature. Heredity is so far both more stable and more secure. The elements of personality are few, but are well organized on a simple, effective plan. The momentum of these traits inherited from our indefinitely remote ancestors is great, and they are often clearly distinguishable from those to be added later. Thus the boy is father of the man in a new sense, in that his qualities are indefinitely older and existed, well compacted, untold ages before the more distinctly human attributes were developed. Indeed there are a few faint indications of an earlier age node, at about the age of six, as if amid the instabilities of health we could detect signs that this may have been the age of puberty in remote ages of the past. I have also given reasons that lead me to the conclusion that, despite its dominance, the function of sexual maturity and procreative power is peculiarly mobile up and down the age-line independently of many of the qualities usually so closely associated with it, so that much that sex created in the phylum now precedes it in the individual.

"Rousseau would leave prepubescent years to nature and to these primal hereditary impulsions and allow the fundamental traits of savagery their fling till twelve. Biological psychology finds many and cogent reasons to confirm this view *if only a proper environment could be provided.* The child revels in savagery; and if its tribal, predatory, hunting, fishing, fighting, roving, idle, playing proclivities could be indulged in the country and under conditions that now, alas! seem hopelessly ideal, they could conceivably be so organized and directed as to be far more truly humanistic and liberal than all that the best modern school can provide. Rudimentary organs of the soul, now suppressed, perverted, or delayed, to crop out in menacing forms later, would be developed in their season so that we should be immune to them in maturer years, on the principle of the Aristotelian catharsis for which I have tried to suggest a far broader application than the Stagirite could see in his day.

"These inborn and more or less savage instincts can and should be allowed some scope. The deep and strong cravings in the individual for those primitive experiences and occupations in which his ancestors became skilful through the pressure of necessity should not be ignored, but can and should be, at least partially, satisfied in a vicarious way, by tales from literature, history, and tradition which present the crude and primitive virtues of the heroes of the world's childhood. In this way, aided by his vivid visual imagination, the child may enter upon his heritage from the past, live out each stage of life to its fullest and realize in himself all its manifold tendencies. Echoes only of the vaster, richer life of the remote past of the race they must remain, but just these are the murmurings of the only muse that can save from the omnipresent dangers of precocity. Thus we not only rescue from the danger of loss, but utilize for further psychic growth the results of the higher heredity, which are the most precious and potential things on earth. So, too, in our urbanized hothouse life, that tends to ripen everything before its time, we must teach nature, although the very phrase is ominous. But we must not, in so doing, wean still more from, but perpetually incite to visit, field, forest, hill, shore, the water, flowers, animals, the true homes of childhood in this wild, undomesticated stage from which modern conditions have kidnapped and transported him. Books and reading are distasteful, for the very soul and body cry out for a more active, objective life, and to know nature and man at first hand. These two staples, stories and nature, by these informal methods of the home and the environment, constitute fundamental education.

"But now another remove from nature seems to be made necessary by the manifold knowledges and skills of our highly complex civilization. We should transplant the human sapling, I concede reluctantly, as early as eight, but not before, to the schoolhouse with its imperfect lighting, ventilation, temperature. We must shut out nature and open books. The child must sit on unhygienic benches and work the tiny muscles that wag the tongue and pen, and let all the others, which constitute nearly half its weight, decay. Even if it be prematurely, he must be subjected to special disciplines and be apprenticed to the higher qualities of adulthood; for he is not only a product of nature, but a candidate for a highly developed humanity.

To many, if not most, of the influences here there can be at first but little inner response. Insight, understanding, interest, sentiment, are for the most part only nascent; and most that pertains to the true kingdom of mature manhood is embryonic. The wisest requirements seem to the child more or less alien, arbitrary, heteronomous, artificial, falsetto. There is much passivity, often active resistance and evasion, and perhaps spasms of obstinacy, to it all. But the senses are keen and alert, reactions immediate and vigorous; and the memory is quick, sure and lasting; and ideas of space, time, and physical causation, and of many a moral and social licit and non-licit, are rapidly unfolding. Never again will there be such susceptibility to drill and discipline, such plasticity to habituation, or such ready adjustment to new conditions. It is the age of external and mechanical training. Reading, writing, drawing, manual training, musical technic, foreign tongues and their pronunciation, the manipulation of numbers and of geometrical elements, and many kinds of skill have now their golden hour; and if it passes unimproved, all these can never be acquired later without a heavy handicap of disadvantage and loss. These necessities may be hard for the health of body, sense, mind, as well as for morals; and pedagogic art consists in breaking the child into them betimes as intensely and as quickly as possible with minimal strain and with the least amount of explanation or coquetting for natural interest, and in calling medicine confectionery. This is not teaching in its true sense so much as it is drill, inculcation, and regimentation. The method should be mechanical, repetitive, authoritative, dogmatic. The automatic powers are now at their very apex, and they can do and bear more than our degenerate pedagogy knows or dreams of. Here we have something to learn from the schoolmasters of the past back to the middle ages, and even from the ancients. The greater stress, with short periods and few hours, incessant insistence, incitement, and little reliance upon interest, reason, or work done without the presence of the teacher, should be the guiding principles for pressure in these essentially formal and, to the child, contentless elements of knowledge. These should be sharply distinguished from the indigenous, evoking, and more truly educational factors described in the last paragraph, which are meaty, content-full, and relatively formless as to time of day, method, spirit, and perhaps

environment and personnel of teacher, and possibly somewhat in season of the year, almost as sharply as work differs from play, or perhaps as the virility of man that loves to command a phalanx, be a martinet and drill-master, differs from femininity which excels in persuasion, sympathetic insight, story-telling, and in the fact that it discerns and utilizes spontaneous interests in the young."

Adolescence. "Adolescence is a new birth, for the higher and more completely human traits are now born. The qualities of body and soul that now emerge are far newer. The child comes from and harks back to a remoter past; the adolescent is neo-atavistic, and in him the later acquisitions of the race slowly become prepotent. Development is less gradual and more saltatory, suggestive of some ancient period of storm and stress when old moorings were broken and a higher level attained. The annual rate of growth in height, weight, and strength is increased and often doubled, and even more. Important functions, previously non-existent, arise. Growth of parts and organs loses its former proportions, some permanently and some for a season. Some of these are still growing in old age and others are soon arrested and atrophy. The old measures of dimensions become obsolete, and old harmonies are broken. The range of individual differences and average errors in all physical measurements and all psychic tests increases. Some linger long in the childish stage and advance late or slowly, while others push on with a sudden outburst of impulsion to early maturity. Bones and muscles lead all other tissues, as if they vied with each other; and there is frequent flabbiness or tension as one or the other leads. Nature arms youth for conflict with all the resources at her command—speed, power of shoulder, biceps, back, leg, jaw—strengthens and enlarges skull, thorax, hips, makes man aggressive and prepares woman's frame for maternity."

[Hall, G. S., *Youth: Its Education, Regimen and Hygiene* (D. Appleton and Company, New York, 1907), pp. 1–6. By permission.]

Careful examination of the foregoing views shows that they are somewhat too theoretical and opposed to the observed facts. There is no period of development when it can be said that any particular mental capacity is not present. There is none in which any particular mental capacity is so marked that this

period is outstanding in this respect. Differences between one individual and another of the same chronological age are very large. The experiences which individuals undergo are so different that their effects serve to obscure to any large degree uniformity of developmental stages. Further consideration of the matter follows:

2. DEVELOPMENTAL STAGES

"*Bodily Development.* Careful study of the physiological changes that take place from year to year as the child grows older shows that these changes are not always uniform, but that there are periods of relativity rapid and relatively slow growth. The periods of rapid growth are somewhat different in boys and girls. Increase in height, for example, in the case of boys is rapid from the age of four and a half years to eight and a half years, slow from eight and a half to twelve and a half, and rapid from twelve and a half to sixteen and a half. For girls, on the other hand, increase in height is practically constant from six and a half to sixteen and a half. Increase in weight in boys is rapid from six and a half to eight and a half, slow from eight and a half to twelve and a half, and rapid again from twelve and a half to sixteen and a half. For girls increase in weight is rapid from six and a half to eight and a half, slow from eight and a half to ten and a half, and rapid from ten and a half to fourteen and a half. While boys are in general taller and heavier than girls of the same age, girls excel boys in height during the ages between twelve and fourteen, and in weight between thirteen and sixteen. This means that girls mature earlier than boys; but as soon as the boys reach the stage of maturity they again excel the girls in both height and weight. . . .

"The figures for increase in height and weight show how difficult it is to give a general statement of the way in which physical development takes place, for the curves of growth in height and weight differ considerably from one another, and the curve for the boys differs from that for the girls. Studies of the other bodily functions and organs, such as lung capacity and size of head, show that these also have their own characteristic curves of growth, differing from those of height and weight. Further-

more, besides the important sex differences that have been pointed out, there are highly important differences between one individual and another of the same sex, which tend to be obscured when the descriptive statement is based on averages. As a matter of fact, the average difference in height and weight between one child and another of the same age is greater than the average increase of the group for a year. As Terman has put it, 'Each individual is a law unto himself. A school child may be several inches shorter and many pounds lighter than the average for children of his age, race, and sex, while fully reaching the standard which nature has set for him.' *

"*Are Bodily and Mental Development Parallel?* The mental life in its various phases also shows fluctuations of rate of development. The question naturally presents itself whether mental development and bodily development are closely parallel or whether they take independent courses. This question is difficult to answer for several reasons, one of which has already been stated. It is difficult to get a general statement of bodily development, to say nothing of mental development, for changes in one capacity do not closely parallel those of another. In the second place, the investigators who have studied this question are not wholly in agreement in their conclusions. If we confine our attention, however, to the relatively sudden changes of puberty, it has been fairly well demonstrated, as Baldwin says, 'that the stages of physical and mental maturity are parallel, irrespective of precocity or brightness. This would require that tall, healthy children of accelerated physiological development be encouraged to proceed through school as rapidly as possible within the limits of thoroughness, and that the small, light children of retarded physiological development be kept below or in the normal grade, doing supplementary work, since these short, light pupils are immature in mental development, although in many cases precocious in degree of brightness. It also follows that rapid, healthy growth favors good mental development, and, therefore, that the healthy growing child should have plenty of physical and mental exercise.'

"*The Culture-Epoch Theory of Mental Development.* A number of attempts have been made to define in more or less detail the

* Terman, L. M., *Measuring Intelligence.* By permission of Houghton Mifflin Company.

stages of development of mental capacities. One of the first of these was the culture-epoch theory. This theory, in turn, was based on the biological law of recapitulation, according to which life changes in an individual run closely parallel to the changes that have taken place in racial history during the course of the evolution of higher from lower forms of animal life. The culture-epoch theory carries this view over to the mental life, and holds that the stages of mental development in the child correspond to the stages through which the race has passed in its evolution from lower forms of animal life to man in his most primitive form and the subsequent progress from savagery to civilization. According to this view, the child at one stage is a hunter, at a later a nomad, then an agriculturist, etc., in his interests and instincts, and his education should follow these interests and in that order. . . .

"Whatever may be said of the truth of the culture-epoch theory in its broader aspects, the most careful study will fail to reveal any exact parallelism between the child and the race in mental development. The culture-epoch theory has failed to give any detailed view of stages of development in the child, though it has undoubtedly been one of the factors in making educators emphasize the importance of child study, and of basing educational procedure on child nature rather than on abstract schemes of what may be regarded from the adult point of view as logically appropriate methods."

Bagley's Stages of Mental Development. "Another form in which the recapitulation theory has been carried over in the description of mental development is given in the writings of G. Stanley Hall and others. This view has been presented in summary form by Bagley, who distinguishes three stages of development. These stages are (1) the transition period (6–8 years of age); (2) the formative period (8–12 years of age); (3) the adolescent period (12–18 years of age).

"*The Transition Period.* This earliest period in the life of the school child is thus named because during this period there takes place 'a * passing over of interest from means to end, from process to product—an initial development from passive to active attention.' Nevertheless, there is but little development

* Bagley, W. C., *The Educative Process,* Chap. XII (1905). By permission of The Macmillan Company.

of capacity for active attention during this period. The child is not able to reason in any real sense at this time. Hence instruction of an intellectual kind must be largely through appeals to the senses and that which is inherently interesting. In the moral sphere the child's action must be forced in the right direction by reward and punishment.

"*The Formative Period.* This is the period for drill and habit formation. 'While passive attention is still dominant, the concentration and effort that active attention involves can be demanded with less fear of disastrous consequences. In the early part of the formative period the capacity for logical reasoning is still nascent, although it would seem to make its presence felt in a slight degree at about the age of nine.'

"*The Adolescent Stage.* The adolescent stage is characterized by mental changes as profound as the physical changes of that period. These changes are first of all of an emotional character. 'Fear, love, pity, jealousy, emulation, ambition, and sympathy are either now born or springing into their most intense life.' The child now acts from social motives rather than individualistic as heretofore. He may now be influenced both intellectually and morally by appeals to reasoning. . . .

"While the picture that Bagley has given is suggestive and instructive, it must be accepted with reserve because (1) it is not based on experimental evidence. All such descriptions are necessarily limited to the impressions gained by observation of children, and there has been much disagreement even among the most capable observers; (2) it tends to exaggerate the suddenness with which mental changes actually occur. It is certainly not true, for example, that the child can reason in any essentially different way after the age of nine from that in which he reasons before that age. The truth is that the child's reasoning capacity is present from the earliest years, and that he is able to deduce conclusions whenever the data are simple enough for him to understand. This capacity in the young child is limited by his lack of experience. Just as untrue is it to say there is ever a time after school age when the child is not capable of some degree of sustained effort and attention. Furthermore, while the physical and mental changes of adolescence are profound, there is little, if any, ground for holding that at this

time the child becomes a new being, or that he becomes suddenly endowed with entirely new capacities.

"*Kirkpatrick's Stages of Mental Development.* Another elaborate scheme of representing stages of mental development has been contributed by Kirkpatrick, who uses susceptibility to social influences as the criterion. On this basis the following stages, may be distinguished: (1) Pre-social. During this period the child is influenced only by objects and by animals and persons in the same way as if they were objects. This period ends near the close of the first year. (2) Imitative and socializing stage. During this period, which lasts till about three years of age, 'the child becomes more and more susceptible to mental influences and his mental states are determined to a considerable extent by the mental states of those around him.' *

"(3) The third stage, which culminates at about six years of age, may be designated as the *individualizing stage,* during which the conscious personality that has been developed during the previous period becomes more distinctly individual and asserts itself, instead of merely assimilating the characteristics of others.

"(4) The fourth stage, ending at about twelve years of age, may be described as the *period of competitive socialization.* It is the period when a child is introduced to a wider social environment and in which the impulses to excel in competition are prominent and are brought out in association with others of the same age.

"(5) The fifth stage, culminating at about eighteen years of age, may be called the pubertal or transitional period. During this time the youth and maiden become more susceptible to many social influences that formerly affected them not at all, and many new and important interests develop that are characteristic of the sex and age.

"(6) The sixth period, ending at twenty-four years of age, may be designated as the stage of *later adolescence,* during which the individual is ushered into the larger world of thought and action and becomes prepared to take his part in the various activities of the race as a fully developed man or woman.

* Kirkpatrick, E. A., *The Individual in the Making,* Houghton Mifflin Company (1911). By permission.

"*Such Schemes Must Be Accepted with Caution.* Like the other scheme just presented, this one must be viewed with the same caution, as Kirkpatrick himself is careful to point out. In reality there are no sharp breaks between these various periods; the capacities of one period are not absent from the preceding and succeeding periods; the ages given must be regarded as only approximate, and even the order of the stages may vary in different individuals.

"It is safe to say that at the present stage of our knowledge no description of the child's mental life in terms of stages of development can adequately represent the facts. Some children develop rapidly at certain periods with respect to a particular capacity, others slowly, and still others gradually. Even when changes occur relatively suddenly, there are frequently great differences in the ages at which these changes appear. Take, for example, the case of instincts. Here, if anywhere, we should expect to find uniformity of development in different individuals. It is true that some instinctive tendencies crop out more or less suddenly, but to argue a general law of development from these cases is impossible. It is a matter of common observation, for example, that some children pass through stages in which fear of certain situations seems to develop suddenly, and after a certain length of time as suddenly disappears. Other children of the same family may not exhibit the same tendencies to sudden development of fear of these situations at all, or if at all they may appear at entirely different times. Of course, it may be said that these differences are due to differences in experience, but as a matter of fact they often occur when they cannot be accounted for in this way.

"The facts of mental development, therefore, at the present stage of our knowledge cannot be adequately described in general terms. We are justified only in presenting the facts that are known with regard to certain capacities that have been measured, and even then it is necessary to remember that these pictures of mental development must be taken with reserve (1) because the measurements have been made on different groups of children at the various ages instead of the same children from year to year, and (2) because it is certain that the differences between one child and another in respect of any particular capac-

ity is frequently greater than that from one age level to another."

[Cameron, E. H., *Psychology and the School*, (The Century Co., New York, 1921), pp. 247–256. By permission.]

QUESTIONS

1. Have Hall's views concerning the difference between the period prior to adolescence and adolescence had any effect on present school-room procedure?
2. Give the reasons for skepticism regarding these views.
3. Are there any reasons related to mental development that underlie the difference between the elementary school and the high school? What are they?
4. If girls mature earlier than boys, what difference should obtain in their treatment educationally?
5. Are bodily and mental development parallel?
6. How are Bagley's periods of development related to Hall's theory?
7. Describe the periods of development as Kirkpatrick portrays them.
8. Give reasons for skepticism regarding such stages of development.

CHAPTER IX

MODIFICATION OF INNATE TENDENCIES

In Chapter III there was included an extract from Watson's writings in which he advocated the giving-up of the term *instinct* as serving no useful purpose. The following quotation comes from an earlier writing of the same author and therefore represents a position which he has since abandoned. It is presented here in the belief that the earlier position is the sounder, and as a remarkably good description of the way in which some of the native tendencies are utilized in learning.

1. INHIBITION AND CONTROL OF INSTINCTS

Socialization of Instinct. "The problems connected with the breaking down of instincts and their replacement by habit are of both practical and theoretical interest. Where instincts are distorted they must often be broken down before normal activities can be given an opportunity for development. Furthermore, many of the perfectly normal instincts must be brought under social control before the individual is prepared to mingle with his fellow-men. One of the earliest examples of the socialization of normal instinctive acts is illustrated by the teaching of the infant continence with respect to its eliminative functions. Here the instinctive activities are left intact so far as the pattern is concerned, but the situation for the release of these activities is made more complex. The mother starts the process of control very simply by taking the child to the toilet every two hours or oftener and leaving it there until those acts are performed, and then bringing it back to its more customary and normal environment. The association grows up rapidly in normal children. Thereafter, the intra-organic stimulus (pressure of urine and fæces) leads the child to make some sign, usually a vocal one, which stimulates the mother to gather it up and carry it to the

proper place for the performance of those functions. As the child grows older, the pressure of such stimuli touches off the act of going to the proper place of his own accord. The extra-organic stimulation (the new situational factor, the sight and contact of the toilet) leads to the act of evacuation. There are thus a large number of habit activities built up around the instinctive function, but the latter as such is left practically untouched except for a momentary initial inhibition (sphincter control).

"A case in which the pattern itself is altered to some extent can be illustrated most simply from animal life. The bird dog when taught to retrieve, at first instinctively bites the bird when he grasps it, especially if it is wounded and fluttering. It is often difficult to get this part of the pattern broken up. It can be done by filling the dead bird with pins. If the dog mouths the bird at all severely, the points prick him and it is necessary for him to close down very gently indeed when he brings the bird in if he is to avoid pain stimulation. Dogs and cats often suck eggs, which is a purely instinctive function with dogs at least. They can be cured by filling the egg with quinine or cayenne pepper. In these illustrations there is the actual breaking down of a part of the reaction pattern by reason of the changes introduced into the stimulus. The stimulus becomes other than it was. Instead of leading now to action *a* plus *b* plus *c* plus *d*, for example, smelling, licking the egg, cracking the shell and lapping up the contents, it leads to action *a* plus *x*, i. e., to smelling and avoiding. Some children suck the fingers instinctively from birth. If not corrected, it may continue long after the infancy period. The most usual way of breaking the instinct is to place something on the fingers that will lead to another reaction (quinine, pepper, etc.), or else to make the action impossible by putting a cardboard tube on the arm so that the elbow cannot be bent. The instinct dies here because the act cannot be completed. Society puts a good deal of emphasis upon right-handedness. If handedness is instinctive as is most generally assumed, we have in the breaking up of left-handedness a study in the displacement of an instinct. Everything is offered to the child's right hand, people shake hands with it with the right hand, parents place everything in such a way that the right hand will be used much more frequently than the left. All habits, then, are built up around the right hand and the left-handedness dies by inanition, i. e.,

through lack of stimulation. Habits of a pernicious character are often as difficult to break up as are instincts."

Principles of Control. "Summarizing the general principle by means of which we break up or control instinct, we may say that we may break up an instinct by (1) arranging the environmental factors in such a way that the instinct cannot take place; the organism is restrained to such an extent that although the movement is initiated, it cannot be completed. Examples, tying down the hand of the child, muzzling the dog, harnessing the cow (to prevent sucking its own milk). While the animal is restrained, we build up habits with respect to those objects which have hitherto been instinctively reacted to—the burglar often feeds the watch-dog in the daytime and speaks to him gently while the animal is tied, hoping that when released at night the friendly habits with respect to himself will inhibit the instinct to rend and tear. (2) On the other hand, we can alter the stimulus, as shown by the illustrations of the doctoring of the egg, putting pepper on the baby's fingers, etc. The stimulus then touches off once at least and usually several times the old reaction, but the new elements added to the stimulus touch off something in addition to the old instinct pattern, viz., an avoidance reaction, possibly also vomiting, hanging out of the tongue to cool it, etc. This phase of the stimulus may become so emphasized that the avoiding reaction may be the first to appear the next time the stimulus is presented.

"In adult life the process of 'habituation' is probably the most potent factor in eliminating especially the instinctive fear tendencies (even though many such reactions are conditioned, they are often fully as powerful factors as if they were native). The movie of a workman going out over a single iron beam twenty stories up from the ground produces many fear reactions on our part and sometimes nausea. If forced actually to walk such a beam suddenly yourself for the first time, it would produce fainting and falling without question. When led gradually to it, it is soon done as readily as any other act. So with climbing to high places, rushing into burning buildings, taming lions and tigers, etc. Habit gradually makes the thing possible.

"An interesting example of the breaking up of an instinct by experimental methods is cited by Partridge. On a visit to Central

Park in New York he noted that the observers around the snakes' cage blinked and jumped back (defensive reflex) each time one of the cobras struck the glass. In order partially to duplicate the situation for an experiment on the breaking up of the instinct he set up a piece of heavy plate glass in front of his subjects and devised a mechanism which would release a rubber-faced wooden-headed hammer for striking against the glass. The hammer struck the glass at the level of the subjects' eyes. At first, of course, the subject blinked and drew back each time the hammer approached the eye. As the subject became more habituated to the situation inhibition occurred. The following figures refer to the number of times the wink was inhibited in each of a series of four hundred trials: 6, 14, 38, 65, 268, 352. That is, inhibition occurred only six times in the first four hundred trials, whereas it occurred 352 times in the last four hundred trials.

"*The Recapitulation Theory.* Under the influence of several non-biologically trained psychologists, a rather persistent but nevertheless pernicious theory of the stages of childhood activity has grown up. This is known as the recapitulation theory. It holds, in short, that ontogeny repeats phylogeny—that the developing child must pass through all the stages that the race has passed through. He should thus by rights pass through a fish stage of activity, a monkey stage, a primitive man stage, etc. Certain psychologists have seriously subscribed to such statements as the following: 'A babe a few days old . . . made peculiar paddling or swimming movements.' * 'In children and adults . . . we find swaying from side to side or backward or forward, not infrequent. This suggests the slow vacillatory movements used by fish.' The best corrective for such harmful conceptions is a real genetic study of the child and a deeper knowledge of biology.

"*Principal Rôle of Instincts.* Though the perfect instincts in man be few in number, his wealth of abortive and instinctive tendencies is quite important. In general it seems safe to summarize the rôle of instincts in man as follows:

"1. Man is supplied with a large number of directly adaptive life-conserving activities which care for the intake, digestion and dissemination of food products and for the elimination of

* Hall, Stanley, *Adolescence.* By permission of D. Appleton & Company.

waste and for procreation. These purely vegetative functions serve him as they serve animals lower than man and are possibly just as 'perfect.'

"2. Man at birth and at varying periods thereafter is supplied with a series of protective attack and defense mechanisms, which while not nearly so perfect as in animals, nevertheless form a substantial repertoire of acts which needs only slight supplementation by habit before being of direct utility to the individual in his struggle for food, against enemies, etc. These are the protective and instinctive attitudes—the instinctive factors predominate.

"3. Then follow the occupational tendencies (manipulation) supplemented by habit—seen earliest in collecting, hoarding, building of blocks, hammering and the use of tools generally, drawing, modeling in clay, etc. In the crude stage of these activities, the instinctive factors predominate and make clear the lines along which habits must follow. The instinctive factors, however, are soon lost sight of in the activities of the skilled workman, the artist and the collector. These differing activities are seen at a very early age in children. Modern school methods, and especially the college, tend to break them down. One rarely finds a lad of twelve who cannot tell exactly what he wants to become, what he is fitted for and why he is fitted for it. By the time he has had all the original manipulative tendencies cultivated out of him in college, he can rarely tell what he is fitted for, and he drifts now into this work, now into that, depending upon his father's business, temporary openings, the traditions of the school, or the aspirations of his parents or other backers. We cannot help but feel that there are enough instinctive leanings present in early youth to properly shape any child's future activities. The problem is to find the method of discovering them, and then to shape the schools and colleges in such a way that these tendencies will be fostered rather than lost. If they are kept central, any amount of culture may be built alongside of them without bringing about their submergence.

"4. Individuality seems in some way to depend upon man's original tendencies, not upon the presence of the completed pattern type of instincts, since these do not exist in any large number, but apparently upon factors which, when taken singly, are difficult to detect, but which when taken together are most im-

portant. There is not much experimental evidence for this conclusion, but there is a great deal of common-sense data. We have in mind such differentiations as follows: Two men with the same and equal training, and approximately equal in ability in any skilled field, each capable of turning out fine work, will show individuality in workmanship, design and methods of approaching their problems. Two equally skilled pitchers or catchers in baseball show this very well. Two men working upon lathes or modeling in clay, or making drawings of the same microscopic slide illustrate it. Apparently there are different fundamental part activities which have persisted in spite of instruction. We dignify these in the artist by the terms 'touch,' 'technic,' 'individuality,' etc. The fact that they have persisted seems to prove their original nature.

"5. . . . The principal rôle of all instinctive activity, neglecting the vegetative and procreative (the latter especially is not lacking in habit supplementation), is to initiate the process of learning. If an object did not call out either a positive or a negative response, the formation of a habit with respect to that object would be impossible, unless we could take measures to condition a response."

[Watson, J. B., *Psychology from the Standpoint of a Behaviorist* (J. B. Lippincott Company, Philadelphia, 1919), pp. 262–268. By permission.]

The part that "interest" plays in learning is recognized by all teachers. There are differences of opinion, however, as to how far the teacher should go in the attempt to secure such interest. Many teachers fear that interest may supplant discipline. A thorough analysis and understanding of the nature of interest and the means of securing it will aid in overcoming the apparent opposition between the doctrines of interest and discipline.

2. NATIVE AND ACQUIRED INTEREST

What Interest Really Is. "Not everyone, not even a psychologist, knows exactly what interest is or what is meant when we use this term. Interest has been defined as: 'the impulse to attend'; as 'the recognition of a thing that has been vitally connected with our experience before, a thing that is familiar or old'; or 'as a natural tendency to act.' One psychologist says 'the root idea of the term seems to be that of being engaged, en-

grossed, or entirely taken up with some activity because of its recognized worth.' Dewey states that it marks the annihilation of the distance between the person interested and the materials and results of his action. According to him, interest is the sign of this organic union between the subject possessing the interest and the objects or materials he works upon. Other writers have made interest synonymous with the feeling of satisfaction or pleasure that always accompanies spontaneous and successful attention. Such a feeling of pleasure may be said to be the sign in our consciousness which notifies us that we are in reality growing interested in a subject or task.

"These definitions will help us to understand and to keep in mind what interest really is."

Effect of Interest on Work. "Such an interest in one's task is very important as every one knows and should be developed and carefully maintained while we study or do our other work. In fact, one of the most necessary conditions for obtaining human efficiency in any line of work is to cultivate such an interest in whatever we have to do; and if we do not feel such a natural interest in our work, to take steps to develop it at once, for keen interest is one of the most important driving forces in life.

"This may be illustrated in a number of ways. A stentor busily engaged in the pursuit of food or if reacting to a particular kind of stimulus, will not respond to another stimulus that under other conditions would elicit a definite response. At such a time its organism seems physiologically 'set' towards a certain stimulus and towards a particular type of movement so that a stimulus which normally excites it to action has no effect upon its behavior.

"The same thing has been shown by experiments on animals. A hungry cat or rat placed in a puzzle box or maze shows by its every movement a mental and physiological adjustment that usually persists until it succeeds in getting out of the box. A sleepy or well-fed cat will, on the other hand, be 'set' less towards escape movements when confined in such a puzzle box or maze. In such instances a certain psycho-physical adjustment has been set up within the organism that helps to determine what responses the animal will make and which creates a sort of inner urge that drives it on to make a type of movement that is continued until the animal obtains an end that may be said to

be desired only in a physiological way. Or if put in terms of attention, or interest, we may say that the cat is very much interested in getting out of the box and will usually stick to the attempt until she succeeds.

"Something like this, only on a far bigger and more complicated scale, is what happens with students, only here a purpose, an idea, a desire, some mental attitude or general feeling tone serves as such an inner urge, and helps to determine what sort of responses the individual will make when confronted by his tasks. Anything he is intensely interested in or is 'set on doing,' he usually finds a way to accomplish. If there is no way, he proceeds to make one.

"This has recently been illustrated by a number of important experiments and incidents from practical life. Rose Fritz won the world's typewriting contest in 1906 by writing 82 correct words each minute for one hour. She told Mr. Kimball, the director of the contest, that she had reached the human limit for this type of work—that she had written as fast as any human being could ever learn to typewrite.

"Mr. Kimball, however, told her she was wrong. He assured her that she had not reached the limit, and convinced her that her own record could be passed. The result was that in the following year she beat her own record by writing 87 correct words each minute for an hour; and the following year she raised her record to 95 words, while to-day the world's record is held by Albert Tangora who wrote, in October, 1924, at the rate of 147 correct words each minute for one hour.

"A study of H. D. Kitson of the increased output of 40 hand compositors in the printing industry showed that when these workers were subjected to a particular wage incentive which interested them in doing more and better work, these seasoned printers who had been working at the trade on an average of 10.3 years made an average gain in output of work of 78 per cent in five months. One man who had worked at the trade 23 years increased his output 289 percent.

"The results obtained in our own study of five different types of learning made with 124 college students emphasized in a still more striking way the value of interest in learning and work. Our experiments were devised to determine the effect which interest in improvement produced upon the progress in learning

made by these subjects. In each type of learning studied, the sections that were being interested in the gains they were making, by the conditions of the experiment, made more rapid progress than did the sections that could not because of the conditions imposed by the experiment become interested in their own advancement. Moreover when the conditions were reversed for the various stimulus and control sections, the same individuals who had been making rapid progress when they were directly interested in their advancement ceased suddenly to improve, while the sections that had been making only slight improvement began suddenly to progress at a much more rapid rate as soon as they were definitely interested by the conditions of the experiment in the gains they were making. In each of the five types of learning studied this interest in improvement not only increased the learner's rate of gain but materially improved the quality of his work.

"Similar results were obtained by Remmers and Knight in an experiment made on college students. Ten college freshmen who had been previously hazed by their fraternity for a week and allowed to sleep only two hours a night were given some tests in addition at 10 P. M. and their results compared with the scores made by an equal number of junior students of equal ability who were tested under the most favorable classroom conditions at 8 A. M. The object of the experiment was to determine how much difference it would make in performing successfully this kind of work when the performers were keenly interested in the work. The freshmen were told by the president of their fraternity that they must push themselves to the limit on these tests as the score they made would determine their final acceptance or rejection by the fraternity. The juniors, on the other hand, had no special interest in the task or in their final score but were told, the same as the freshmen, to do their best on every test.

"Under the conditions of this experiment the freshmen made an average of 21 columns of addition for each five minute period of work in all the tests while the juniors made an average of only 11 columns per test. In other words the interest or special motivation which these freshman students had, not only offset the extreme fatigue produced by the hazing but further offset freshman vs. junior ability, and in addition produced twice as much work per unit of time with equal accuracy.

"Other examples of the effect which such an interest regularly produces might be cited. For example one of the biggest manufacturers in Chicago told his office employees a few years ago that they could have all day Saturday every week for a holiday if they would complete all their work in the remaining five days. They did it easily after that and have enjoyed a five-day week for several years.

"These experiments indicate the effect which interest in a task or in one's own advancement really produces and show why we should learn how to become interested in our tasks and work, for interest is a necessary condition for doing any task exceedingly well. We should, therefore, next ask why interest aids a learner or worker in these ways and how such an interest in a particular subject or task like elementary or educational psychology may be developed in an individual or class."

How Interests Are Acquired. "Our early and strongest interests are, of course, all hereditary, but as Professor James has pointed out, most of the interests of an adult have been acquired during the course of his experience and training. 'An adult man's interests,' he says, 'are almost every one of them intensely artificial; they have been slowly built up. The objects of our professional interests are most of them in their original nature repulsive; but by their connections with such natively exciting objects as one's personal fortune, one's social responsibilities, and especially by the force of inveterate habit, they grow to be the only things for which in middle life a man profoundly cares.' *

"This gives us the key to the cultivation of any interests which we may desire to develop in our pupils or in ourselves. We can make our interests practically anything we will if only we know how, for the process takes place according to a few definite laws. The first and foremost of these laws is the fact that all new and acquired interests must be built upon the native interests or tendencies to response with which an individual is already endowed.

"This means that if one wants to develop an interest in a particular subject or task he must first of all find something about this new subject or thing that already interests him. For example, the writer once aroused a genuine interest in Latin in

* James, William, *Talks to Teachers.* By permission of Henry Holt and Company.

a high school boy who was failing in this subject and had learned to thoroughly detest it. In a conference we found that this boy was intensely interested in being a physician and had his future career as a surgeon rather carefully planned. He put in all his spare time loafing at a drug store up town and spent much time visiting a doctor who had taken a personal interest in him. 'Harry,' the writer said one afternoon when school was dismissed, 'I want you to go to Shaptaugh's drug store,' naming the place where he regularly spent his time after school, 'and copy the names of 50 drugs from the bottles on the shelf and bring me the list tomorrow afternoon. Then I want you to go to Dr. Anderson's office (Harry's favorite physician) and copy from his medical books the name of 50 important diseases and bring that list of names with the other list.'

"Little more was needed. Practically every name Harry had on the two lists was either a Latin term or a word of direct Latin origin. This fact interested him at once and was a sufficient incentive for him to apply himself, in a gingerly way at first, to the Latin he had learned to detest. As soon as he began to apply himself to the work he not only began to succeed but became genuinely interested because of the action of a second law that governs the acquisition of all interests that we ever acquire.

"This law may be stated as follows: 'In order to develop an interest in a subject or task secure much information about it.' This principle is appealed to when an advertiser or salesman gives his prospective customers important information about the article he wishes them to buy. It is the law that has operated in building up in every scientist the keen interest which he has in his specialty. That is to say a scientist's interest consists in large measure of the knowledge that he possesses in a particular field. The writer, for example, was not always interested in psychology, but by the steady accumulation of facts in this field an interest in this subject has been gradually developed that amounts almost to passionate absorption, an interest that has completely overshadowed, even eliminated most of the native interests that formerly dominated his conduct and thought.

"If a given piece of work or subject does not in and of itself interest us or our students we should therefore stimulate them to think with intense enthusiasm of the other desirable things to which it may be a means, and to begin at once to get more in-

formation about the problems in this field. The former method was used to develop interest in the 40 printers studied by Dr. Kitson, who made such marked advancement in developing more efficient methods of doing their work. When this experiment began these men had been engaged in the printing trade for an average of 10.3 years. A record of the average amount of work done was taken at the end of the first week after they began to work in the plant, and before the special wage incentive used to interest them in learning to do more and better work began to urge them on to improve their methods of work. The records made during their fourth, eighth, twelfth, sixteenth, and twentieth weeks of service were used to measure any improvement in skill that might have taken place during this time.

"One of the rules of this particular industry was that every employee could get more pay for all the work done over a certain amount which was placed, after much experimentation, at a point considerably above the skill of the average journeyman printer in the trade. As a result every one of the 40 men whose record was studied boosted his output above this bonus point, the average rate of improvement being 78 percent in five months. In other words, the average rate of work of these seasoned printers had been only about three-fourths of what they could easily learn to do if sufficiently interested in making further improvement in their methods of work.

"A third law governing the acquisition of interest is the fact that one must arrange matters so that he can and will succeed with all his work. No genuine or lasting pleasure can be attached to a subject, or to the performance of a task, unless the worker is succeeding with his tasks. New things must be stated in terms of the old. The unknown in terms of the known. Unless this principle is followed and the worker is kept succeeding most of the time, no genuine interest in the subject can be developed. In other words success is required to make a student exert himself fully and vigorously towards his tasks, which is the final and most important law that controls the development of what is generally called interest.

"The operation of this last law in the development of interest is well illustrated by a story recently told the writer by one of the leading superintendents of schools in the United States. In discussing how interest in a particular school subject

might be developed, he related how the best teacher he ever had proceeded to develop it in a class in general science in the high school. This teacher, he said, always began with an object that was thoroughly familiar to every member of his class. One day it was a bean which they put to soak and watched sprout and grow during the succeeding days. While this was going on they dissected another bean and determined the structure and function of its several parts: the hard outer shell, the inner covering, and the food portion stored inside these coverings, which the young plant consumed as it grew and developed a way of extracting its food from the soil and the air.

"The next week this teacher asked each member of the class to bring a hard-boiled egg for inspection and study. All now readily discovered on the basis of what they had done with the bean, the hard protective shell on the outside, the inner lining, and the mass of food on the inside for the embryo chick which they later watched develop in another egg as the experiment proceeded, discovering for themselves a principle which governs an important life process in both the plant and animal world.

"On another occasion the class was given a bit of information about a certain plant that was dissected and studied in class, and two of the pupils were asked to go to a certain swamp some seven miles distant to secure for class use the next day a closely related plant, the skunk cabbage, which they were told was exceedingly rare in that community. Just enough information had been given these boys to arouse their curiosity about the new plant and to enable them to identify it by its peculiar odor. Their native and previously acquired interests were appealed to by having them use the principal's horse and buggy for the seven mile drive after the plant, and by the fact that they were made responsible for securing a new specimen for class use on the following day.

"That these and a score of other similar incidents were remembered by this man and by all living members of his class for 30 years when the author of our story recalled them in that city in a commencement address is proof of the keen interest which this great teacher had developed by the simple rules already discussed. (1) First, he had them secure definite information about each subject and object they studied. (2) He always stated the new in terms of what they already knew or

had previously done. (3) He made it possible for them to succeed with everything he asked them to do. And (4) he always had his students actively engaged on some project or bit or work, exerting themselves actively towards each problem they took up for study. In fact, so successfully was this done and so great was the interest aroused in each subject taken up in the class that this superintendent's younger brother and mother joined in practically every experiment that was performed in school, an experience which was duplicated in practically every home represented in the class, I have been told.''

[Book, W. F., in *J. Ed. Psychology,* Vol. XVIII, pp. 2–10. By permission.]

One of the major tendencies in education to-day is the rapidly increasing responsibility that schools are assuming for the mental health of pupils. There is a consequent disposition to reckon with the emotional life of the child, and study the effects of ordinary school life on the non-intellectual phases of the child's development. Of the two articles now presented, the first treats of emotions from the standpoint of their normal control and development; the second gives in summary form the doctrine of the psychoanalytic school in regard to both normal and abnormal emotional responses.

3. THE EDUCATION AND CONTROL OF THE EMOTIONS

Neglect of This Phase of Education. ''It is coming to be recognized more and more clearly that the native tendencies and capacities of the child furnish the raw material which it is the function of education to work over and to make available for the needs of the individual as an efficient member of society. In the past, the school as an educational institution has devoted its energies almost completely to the cultivation of a selected portion of this native equipment of tendencies and capacities, namely those which are concerned in the processes of cognition —the intellectual processes. The emphasis in the work of education has been put upon the development of the 'mind,' and has stressed such factors as memory, reasoning, abstraction, generalization, and the like. To that portion of the native equipment which includes the affective side of life, made up largely of what

are known as the feelings and the emotions, comparatively little attention has hitherto been paid.

"The school's neglect of this large and important part of our native equipment has been due to three reasons: (1) a mistaken conception of the school as an institution adapted primarily, if not solely, to the training of the intellectual 'powers and capacities,' and the inculcation of knowledge in the shape of information; (2) a lack of comprehension of the value of the emotional side of life; and (3) the absence of any method or system which might be applied to the training of the emotions in the same way that method is applied to the intellectual subjects. All three of these reasons have continuously been operative, although of course not always with the same degree of influence. The school has been narrowly intellectual; the emotions have been undervalued, even to the extent of being looked upon, with only a few exceptions, as detrimental and fit only for control by repression; and so complex is the question of their origin and nature that very few principles relating to their education can be laid down, to say nothing of any systematic method. Difficult as it has been to develop a method for the education of the intellect, it is a still more difficult task to formulate a systematic method which may be applied to practical use in the education of native capacities of whose real nature we are so ignorant as we are of the emotional tendencies.

"But these reasons for the neglect of emotions in both the theory and practice of teaching are beginning to lose their cogency. The school is taking on a broader life, and is no longer content to leave the development and training of the emotions entirely to outside influences. Educators of the present day realize the necessity of making use of all the capital afforded by original nature, for they have come to see that the mind is not composed of intellectual and emotional faculties set over against each other, but that there is a very vital connection and interplay of thoughts with feelings. A saner understanding of moral questions has accompanied the growth of the idea that original nature cannot be essentially 'wrong,' and we have come to understand that features of the emotional life which have heretofore been looked upon as fit only for repression, need only control and redirection to become of the greatest value; and that we cannot at all afford longer to leave them out of account in our

educational scheme. We are also making progress in our knowledge of how to control and educate the emotions. The great and increasing interest which psychologists are showing in topics connected with the nature and origin of the affective states has led to a better understanding of them, and has given us practical suggestions as to methods of their control. It is true, as I have said, that nothing like a system, in the pedagogical sense, has yet been formulated, and that as yet most of the literature upon the education of the emotions is devoted to a discussion of the end that should be reached, rather than of the methods by which the desired result may be accomplished. But what we have serves at least as a beginning, and it is not too much to hope that some day, and not so very far distant, we shall have a practical method for the development and control of the emotional life.

"Although this topic has suffered such neglect it is one which is of the greatest importance. The school wishes to know how to provide for the proper development of the right kind of emotional life in its pupils. Individuals wish to know how to favor the development of the good emotion, and to call it into being; and, more often perhaps, how to inhibit the expression of injurious emotional states. A knowledge of how to influence the feelings of others, of how to produce a desirable emotion or discourage the appearance of an undesirable one, would be of the utmost value to any teacher in the work of imparting instruction, as well as in the attempt to develop a well-balanced emotional life in his pupils. Nothing more than a few hints is as yet available for guidance in this kind of work, but meager as our information is, it is of great practical value, and any teacher who makes a really serious effort to apply it will secure important results."

Training by Means of Repression. "The training of the emotions, as the training of all the instinctive tendencies, involves the encouragement of the useful ones, including provision for their exercise; the careful direction of those which are either good or bad, according to the nature of their objects; and the discouragement, by inhibition or redirection, of those which are positively harmful. In this latter case, inhibition may take place by direct repression or by substitution. Probably no more common or characteristic device for educating or training the child's emotional reactions is used by adults than direct repression.

Many parents have the habit of saying 'Don't' to almost everything the child has a mind to do. This sort of repression may be effectual in subduing at least a part of the outward expression of the emotional state, but as a means of control it is incomplete, because it does not go back to the source or beginning of the emotion; and it may result in actual damage because of the repression of the outward act, while the emotional stress goes on under the surface just the same, although denied its natural outlet."

Natural Punishments. "Of course, the general rule by which a teacher may be guided in his effort to develop good emotions is to provide every opportunity for the origin of such emotions, and then to see to it that the proper expression of the desired feeling is rewarded with pleasure, so that a definite connection may be set up between the emotional state and the pleasurable consequences. Conversely, in case of the harmful emotion, as far as possible every situation which tends to call it forth should be avoided, and unpleasant consequences should be connected with its expression. This use of pleasant or unpleasant results is only an application of Spencer's 'doctrine of natural punishments.' Its value here lies in the fact that experience, which involves the natural force of individual and social consequences, is a great molder of emotional life."

Art and Literature in the Training of Emotions. "Among educational writers a favorite prescription for the training of the emotions in connection with the work of the school is to use to this end art and literature, including biography and history. Horne, who has made a definite attempt to formulate a pedagogy of the emotions, places much emphasis upon this point, saying that art, literature, and history are the most effective instruments in educating the feelings; and Bagley makes history, religion, literature, and the various forms of art the chief media for the transmission of emotions. The psychological basis for all this is in the law that to arouse any emotion, we should arouse ideas which have gone with that emotion in the past. If the child has not sometime experienced the desired emotion in connection with the ideas which are presented to him by the work of art or literature, or which come up by association, he will not feel it, except in the possible case of a situation so vivid as to arouse an instinctive response. It may be possible for the

teacher, however, by presentation of different ideas, finally to call up the emotional state which is sought. The difficulty in doing this will depend, of course, upon the nature of the particular emotion or sentiment, and especially upon the frequency with which it is found to exist among children of the given age. It must be remembered, also, that the situation as presented in a picture, for example, does not call up precisely the emotion that would accompany the actual event. What we actually have in such a case is an æsthetic emotion—what Thorndike calls a 'pseudo-emotion'—which does not cause the same strain as an actual emotion. But these emotions contribute much to the richness of life, and their reactions are not nearly so fatiguing as are those of the real emotions, which, in general, should be aroused only for the sake of action."

Arousal of Emotions Through Imitation. "A method of arousing a given emotion in a given situation, which is somewhat analogous to the teacher's use of art or literature, is the communication of it through imitation. 'If the teacher and half of the class are thrilled with admiration for a member of the class who has honorably confessed his unfairness toward a classmate, the rest of the class will be more likely to admire him also.' * This is only a particular case of suggestion, or the influence of the 'strong idea,' which may also sometimes be used by one individual over another, for the 'spread' of an idea or sentiment, which may go on to completion in an overt act."

The Principle of Bodily Response. "As an outgrowth of the James-Lange theory of the bodily origin of the emotions—although the principle was acted upon before that theory was announced—we have the insistence upon the bodily attitude of the expression of a given emotion as a means of furthering the development of that emotion. This method of emotional control is perhaps more frequently mentioned than is any other. James says that, within the limits of verification, experience corroborates rather than disproves the statement, correlative to his theory, that the voluntary arousal of the so-called manifestations of a special emotion ought to result in that emotion itself. Panic is increased by flight, grief is increased by giving way to its outward symptoms, melancholy is induced by a moping pos-

* Thorndike, E. L., *Principles of Teaching*, p. 199, *A. G. Seiler*. By permission.

ture, and cheerfulness is the outcome of deliberately cheerful conduct. In his investigations, he finds that about one half of the actors questioned upon this point experience the real emotion to which their art gives external portrayal, and he accounts for the other half by saying that in them the visceral and organic part of the expression can be suppressed, and that it is probably on this that the chief part of the felt emotion depends. According to James, then, when we wish to cultivate a certain disposition, we should go through with the movements which make up the outward manifestation of that disposition.

"Thorndike follows James in stressing the value of assuming the characteristic bodily response in order to arouse a given emotion, or to establish a desired attitude or disposition. In illustration of how this may be done in practice, he writes:

" 'Let the frightened one walk steadily toward the enemy, looking him square in the eye, shouting in a loud voice, "I'm not afraid of you, I'll eat you alive," and brandishing his weapon as if about to knock down an elephant—and fear may be replaced by courage. If the kindergarten teacher who feels disgust at a dirty misshapen baby whose face is covered with sores and pimples will treat him just as she would a dainty, red-cheeked picture of health and cleanliness, take him on her lap, pet him, smile at him and caress him, she will often find disgust giving away to tolerance and even to affection.

" 'This . . . is indeed the surest way to secure the presence of an emotion. In the long run our feelings grow into harmony with our conduct. Greed cannot live unsupported by greedy acts; the manifestation of love begets it; get pupils to act as they would if the emotion was felt and they will feel it, or, if they do not, they will not need to. For in any case they will have the really valuable feature of the emotion, its influence on conduct.'

"Münsterberg says that the feelings are essentially motor reactions, and that it is therefore possible to educate and train them through voluntary control of the movements in which they express themselves. The control of emotion, then, lies in the control of appropriate movements. To get a child to appreciate a picture, for example, put him before it and have him assume a 'liking attitude,' and the movements of this response will set up the emotion. While it is impossible to say to just what extent one

can control his emotions and feelings by assuming appropriate bodily attitudes, there must be something in the principle that, in order to cultivate a certain disposition, one must act as if he already possessed that disposition.

"In order that the emotional life may be sound and healthy, the same conditions must be true for the body. Bodily health and activity make for a normal and happy emotional life. The emotions should have serviceable outlets, through right motor expressions. Burt insists upon the need of an 'emotional hygiene,' which shall include exercises in emotional expression, of some such nature as the system of eurhythmics developed by Dalcroze. Other means of physical outlet may be provided by sports, games and plays. Support is lent to the argument for provision of these outlets by the recent work of Cannon, who finds that the 'coarser' emotional states are accompanied by an increased secretion of adrenalin with its resultant physiological effects. Crile says that the vitalizing fluids which are thus released may cause physical injury unless they are consumed by action, and that an unexpressed emotion is measurably relieved by muscular activity. For furnishing such relief, the value of games, especially such as take the form of a contest, is apparent."

Control of Emotion Through Classification. "According to Pillsbury, the only real control of emotions is that which is effected at the source, and this is available only to some degree. His recipe for emotional control is to classify, and thus control, the situation which calls the emotion forth. The control of emotion, or of emotional expression, therefore, is chiefly in terms of the attitude which one takes toward the stimulus. This attitude is to a considerable extent under one's control, at least when falling outside that class of fundamental instincts which are most closely linked with their stimuli. Sensations and stimuli which are capable of being classified in different ways arouse different emotions upon the basis of that classification. For instance, a chance remark may be classified as an insult and arouse the emotion of anger, or the same remark, coming from a friend, may be classified as a jest and arouse an emotion of an entirely different sort. This 'control of attitude' is a sort of all-inclusive expression which covers several principles to which various authors have given different names. It really implies the inhibi-

tion of emotional expression by the application of the judgment, —the 'intellectualization' of the situation, so to speak. It involves, as Thorndike says, learning to judge the situation objectively by the facts, not subjectively by the feelings about those facts; and then following the judgment rather than the feelings.

"If the emotional situation involves a personal stimulus, this application of judgment may have the effect of changing the stimulus from a personal to an impersonal nature, so that when the personal elements are once taken out of the stimulating situation, the emotional reaction loses its 'zest' and rapidly fades away. Since feelings can thus be reached indirectly through ideas and actions, it is possible sometimes for a teacher to relieve an over-emotional state in a child by counseling and reasoning with him. Explanation of the situation in all of its bearings may change the object of the feeling and draw it off into harmless or, it may be, even into useful channels."

Diverting the Attention. "Another way in which the expression of an emotion may be prevented is by 'directing the attention' to something else, until the occasion for the emotion is past. A person who found himself in a situation normally provocative of anger, and who did not wish actually to become angry, might be able to turn his attention to something, inside or outside of the situation, of such a nature as to make it possible to 'keep his mind,' as we say, off the particular factor which would otherwise stir up the emotion which he was seeking to inhibit. In effect this is but another application of the principle of bringing about a change in the stimulus, without necessarily involving 'reclassification.'

"Of those emotions which are good or bad only as they are directed to objects which are proper or improper, the method of control involves simply proper direction. Ambition, pride, anger, and other similar emotions, have their uses and are too valuable to be lost, but unless directed toward the proper objects, they are not only useless, but positively harmful. While hate, for instance, is entirely wrong if directed toward anything or anybody that is not the proper object of that emotion, it is, on the other hand, a matter of great importance to be able to hate aright,—to hate the things toward which that emotion has its proper direction.

Sublimation. "This method of control by direction is very closely allied to what is known as sublimation. The Freudians use this term exclusively in connection with the sexual instincts and the emotions connected with them, but by a somewhat similar interpretation it may be made to apply equally well to other emotions. It means the 'long circuiting' of the instinct or emotion by associating it with other and better sentiments. Colvin and Bagley, in their *Human Behavior,* define it as * 'the method which attempts to lift a strong feeling bodily out of the instinct to which it naturally belongs and to fasten it firmly to another object and to an entirely different process.' A rather commonly given illustration of this operation is the development of the sentiment of chivalry at about the time of adolescence as a sublimated form of the newly awakened sexual emotions. Colvin and Bagley give two excellent illustrations which I quote:

"'A very good illustration of an effective attempt to "sublimate" a primitive instinct is to be found in the success of the Salvation Army. Here we see a military organization with innumerable suggestions of actual physical combat enlisted in the service of the most peaceable ideals. The Boy Scout movement (as it has been developed in America) makes a similar use of the feelings connected with several of the primitive instincts, attaching them to other objects and insuring responses that are only symbolic of the actual primitive responses.'

"All of this means that an effective mode of emotional control lies in the formation of attitudes, ideals, and sentiments, by attaching appropriate ideas to the original emotion as a core. Much may be done in this connection by deliberate resolution to develop the appropriate attitude. Thus suppose one decides that he does not wish to give way to anger in a certain situation in which he often finds himself. Let him then make a deliberate resolution to avoid that situation as much as he possibly can, and thus give the emotion the fewest possible occasions for being aroused. Let him further resolve that, if he does find himself in the provocative situation, he will by no means allow his temper to get the better of him, that he simply will not become angry, that he will follow his judgment and change the stimulus; and he will have gone a long way toward the accomplishment of his

* Colvin, S. C. and Bagley, W. C., *Human Behavior.* By permission of The Macmillan Company.

purpose, and started upon a method which will become more and more effective as he continues to practise it."

[Henry, T. S., in *J. Ed. Psychology*, Vol. VIII, pp. 407–415. By permission.]

4. PSYCHOANALYTIC VIEW OF EMOTIONAL CONTROL

The Three Basic Instincts. "One of the difficult problems upon which the science of psychology is at present working is the classification of the human instincts. Although at present there is considerable difference of opinion among psychologists as to this classification, there is rather general agreement that the socially dominant instincts are the instinct of self-assertion, the herd instinct, and the sex instinct. These instincts are universally found in normal human nature and also appear the basis of many of the other so-called instincts. The self-assertive includes several different forms of self-regarding impulsive reactions, notable in modern behavior, the socialized hunger urge. It leads to activities that protect the existence of the individual. The second, the gregarious instinct, emphasizes the social relationships of the individual and has much to do with the bringing about of organized social life. The third, the sex instinct, perpetuates the race and also makes possible altruistic interests that could not arise, were the individual under the dominance of the egoistic instinct alone. The social conduct of men and women is necessarily influenced more by these three fundamental pattern reactions than by any of the others. A large part of the problems of human behavior is concerned with the adjustment and harmonizing of these three basic instincts.

"It is natural that these fundamental reactions should often be in collision. Man's environment is so complex and the stimulations that operate upon him, so many and so various that we find the three chief instincts brought into discord. This is the origin of most of the conflicts that have such a controlling influence over behavior. As a result of inheritance and early experience the instincts of self-assertion, of the herd, and of sex are expressed in differing intensity in different individuals. Each of the instincts also is excited to greater degrees of strength according to the particular circumstances of the environmental situation present at the time when the individual expresses his reaction. Frequently one instinct obstructs the expression of another.

The opportunities for conflict between the self-assertive tendency and the herd-regarding attitude are particularly numerous. As one instinct meets obstructions it throws its momentum back upon the mind itself, and an adjustment of the individual's self-expression follows the checking process. All sorts of relationships become possible, due to the limiting and conflicting influences of the primary instincts upon one another."

Need for Adjustment of These Instincts. "Each individual is always attempting to bring about a satisfactory adjustment of the three major interests. Such a harmonizing of the different instinctive cravings is not only difficult but it is necessarily temporary. The mere expression of one instinctive reaction brings forward a conflicting desire and thus the adjustment is broken down and the process has to be gone through again. Moreover, all the changing influences of body, mind, and social experience operate upon the individual, perhaps checking one of the three instincts, while at the same time stimulating to the utmost the other two. Every possible combination of instinctive reaction is characteristic of normal human experience. As a result the individual is largely in persistent struggle for inner harmony, and the inner self may even at times be tumultuous because of the intensity of the conflicting interests."

The Complex. "Definite, habitual reactions based upon one of the primary instincts may become established in the mind and have for the individual a very great emotional content. This is what is meant by the complex. The complex, in its widest sense, is a connection of ideas, due to previous experience, which has for the individual a large emotional value. Emotions connected with the complex are usually beyond what the experience justifies. Indeed, emotionally the complex may be contrary to facts. Modern psychology uses the term complex with much the same meaning that Professor William James gave to the 'self' when he pictured the individual as made up of different selves, each sympathetic toward experiences in harmony with its emotional character and hostile to new experience in discord with its feeling tone. In other words, the self so long as it occupied consciousness would attempt to perpetuate itself and to discount the meaning of experience destructive to its own dominance. The more modern term, 'complex,' makes the situation much clearer. It also calls attention to the process of development. . . ."

Illustrations of Complexes. "Suppose a conscientious boy finds himself, as a result of suggestion and opportunity, guilty of theft. He conceals his behavior and the thought of what he has done becomes a nucleus for various experiences of fear, desire of confession, suspicion that he is discovered, efforts at emotional compensation, and other allied reactions. The more he thinks about his bad behavior, the more significant it becomes. Perhaps he finds himself occupied with thoughts of his theft constantly during the waking day, especially when his mind wanders from any engrossing activity. A complex has formed itself, which in this case is distinctly hostile to the inner poise and pleasurable tone of the individual. Under such circumstances the boy can react to his complex in one of three ways. He may try to forget what he has done and thus push the experience as far as possible outside of consciousness. In this way he drives it into what is known as the subconscious. Even when it does not appear clearly any more in conscious experience we are sure that it has not departed from his life since it is almost certain to show itself in the dream experience. This attempt to be rid of the disagreeable association of ideas by forcing it out of consciousness is known as repression. On the other hand, the boy may adjust himself to his behavior by trying to rid himself of a sense of blame. In this case he struggles for harmony by loss of moral scruples. Effort is made to adjust the entire personality to the guilty experience and make that characteristic of his personality. A third reaction and perhaps the most harmful possible is to take refuge in phantasy. If this is done, the boy will try to convince himself that the theft was never committed and that therefore he has nothing to blame himself for and is in no risk of detection. If this policy is assumed, he will have to color the actual facts of life more and more in order to make the unreal thing seem true. . . .

"Another common form of complex with which everyone is familiar is the attitude of the person with one idea or with one book, or with very strong bias. This single interest brings into association a large number of different experiences because emotionally this person is always feeding his complex and is blind and hostile to anything that would cause the undoing of the association of ideas which for him has come to have such importance.

"It is interesting to notice how the purpose of the moment

tends to bring forward certain complexes and to suppress others. For example, with the coming of the day the man of industry finds his imagination going forward to the tasks at hand, and the complexes related either appear in consciousness or are easily brought forward when the appropriate stimulus arrives. With the coming of evening and the possibilities of recreation, an entirely new set of complexes take their place ready for emergence into consciousness. . . ."

Inhibiting Effects of Complexes. "Complexes that are stimulated but find no means of expression irritate very deeply. This is one of the fatiguing elements of modern life. All about us are stimulations, often purposely organized to stir up complexes of a definite sort with the expectation that the individual will respond with the desired conduct. The advertisement, however, that stimulates self-expression in one individual, according to the will of the advertiser, is blocked by the financial circumstances of another individual so that the complex, although stimulated, can not pass to the appropriate activity. Under such circumstances the individual becomes restless and dissatisfied. Where the emotional strength of the complex is very great, its blocking brings a profound discontent and issues forth in a serious conflict."

Rationalization. "A large part of our thinking is occupied with efforts to defend complexes which we already have. This process of protecting ourselves from the painful attempt at self-scrutiny is known as rationalization. The mind finds reasons for the dominance of the complex. We bring to bear all the resources of our experience to establish more firmly the associated ideas that are already over-valued and distorted. It is this habit of rationalization that makes self-correction so difficult and takes away from thought a large proportion of its possible value. Instead of using our thought to bring about the wisest possible adjustment, we expend it in the futile effort to make rational the attitude which by its very constituency is contrary to our welfare. . . ."

Pathological Complexes. "When the complex becomes tremendously emotional and occupies a large part of the person's life, disturbing the equilibrium of the individual in nearly all his doings, we have what we call a pathological complex. It is stronger than the ordinary complex and also more clearly em-

bedded in the subconscious. It has passed not only beyond the control of the individual but also beyond his knowledge. It is like a foreign element in his life. It intrudes itself into all his thinking and action and shows itself especially in experiences that portray the working of the subconscious, such as dreams, neuroses, and insanities. Some psychiatrists limit the use of the word complex entirely to these more violent experiences. The pathological complex in spite of its abnormality is usually formed in much the same way as the more ordinary complex. It represents the enormous development of a systematic association of ideas of high emotional content, which finally comes to have such importance in the life of the person as to represent the same kind of situation that we find in the hysterical patient who develops multiple personality. It is a sort of self within the self, showing its pernicious influence at every opportunity in conduct."

Importance of the Unconscious. "In dealing with the complex it is important to keep in mind the significance of the unconscious life. In order to deal with the actual experiences of the human mind it has been necessary to construct the hypothesis of the unconscious. This provides an explanation for the appearance in consciousness of ideas and impulses that are not related to the preceding experiences of consciousness and are not the product of outside stimulation. This unconsciousness is not subject to the direct control of consciousness but its influence enters consciousness like an intruding energy. The unconscious complex spreads along lines in harmony with the characteristics of the individual unconsciousness and as its effect from time to time appears in consciousness it may be out of harmony with the conscious personality. Thus the coming into consciousness of influences of unconscious origin is at least mysterious to the person and sometimes actually oppressive. It has been found from experience that the emotional conflict due to these influences of unconscious origin can be happily dissolved by the process of bringing into consciousness a clear understanding of how the difficulty has arisen. This process, known as psychoanalysis, is the product primarily of Dr. Sigmund Freud, of Vienna, Austria, who by attracting attention to the significance of the unconscious origin of emotional conflict has given the physician a new insight into mental disorders. Dr. Stanley Hall has perhaps

best portrayed the importance of the unconscious by comparing the mind to an iceberg. The smaller part above the surface of the water represents consciousness; the greater part, hidden, is the unconscious life.

"Although this unconscious life is differently interpreted at present by students of psychology, its significance for the social conflict is universally admitted. In actual practice the psycho-analytic method requires great skill and can be used safely only by those who are thoroughly trained and experienced. The reason for this is in part the fact that just as soon as any effort is made to dig into the unconscious by extending processes of memory, resistance is developed by the person, since these experiences that are concealed in the unconscious are largely the results of having driven from conscious attention ideas or experiences unpleasant to the person. Increasing resistance to the physician's probing results from the psycho-analytic process. This, and also the possibility that the real difficulty is organic rather than mental, precludes the amateur from using psycho-analysis in cases of mental difficulty. Those who deal with people, however, find a knowledge of psycho-analysis of great assistance in meeting the ordinary difficulties of social contact. Knowledge of psycho-analysis gives the student of social behavior insight into the motives that influence people, and teachers and parents are particularly helped by familiarity with the general principles of psycho-analysis."

[Groves, E. R., *Personality and Social Adjustment* (Longmans, Green & Co., New York, 1923), pp. 36–47. By permission.]

QUESTIONS

1. What are the general principles of the control of instincts? Illustrate.
2. The principal rôle of instinctive activity is to initiate the process of learning. Explain this statement. What other rôles may instincts play?
3. From the standpoint of function, what is the chief difference between the child and the adult?
4. How does the acquisition of ability to walk differ from learning to talk?
5. Distinguish between temporary and permanent associations.
6. What is interest?
7. Give illustrations of the importance of interest in producing efficient action.
8. State three principles governing the acquisition of interests.
9. What are the reasons for the neglect of the education of the emotion?

10. Why is repression an incomplete means of control of emotion?
11. What is the value of cultivating emotions through the arousal of their motor accompaniments?
12. Explain how emotions may be controlled through intellectualization.
13. What is control of emotions through direction?
14. Explain: *complex, rationalization, pathological complex, psychoanalysis.*

CHAPTER X

PERCEPTUAL OR OBSERVATIONAL LEARNING

That type of learning which is concerned with the immediate experience of objects and events in the external world has two main aspects. It consists, on the one hand, of a "consolidation" (as the author of the following statement puts it) of sensory impressions, together with the development of perceptual meanings. On the other hand, along with this development, and as an essential part of the total process of learning, motor habits are being formed. The application of both these principles to education is well expressed in quotations from Professor Judd and the late ex-president of Harvard University.

1. HOW EXPERIENCES ARE CONSOLIDATED INTO INTERPRETATIONS OF MEANING

Consolidation of Experiences. "Did you ever ask yourself why it is that we have two eyes and two ears? We all recognize the fact that we need two legs in order to make walking possible; that we frequently need two hands—one to hold the object on which we are working, and the other to do the manipulating. But I venture to say that most people are not aware that seeing is never perfect unless both eyes are coöperating, and that hearing is never complete unless both ears are in use. The truth is that natural and complete visual and auditory experiences are just as much dependent on our two organs of sight and hearing as natural walking is dependent on the combined action of two legs. And the unfortunate individual who is deprived of one eye or one ear, has to make use of unusual and clumsy means of sight and hearing, just as the man deprived of one of his legs has to make use of clumsy devices for walking.

"Let us demonstrate this in a simple experiment with hear-

ing. The experiment is one which can be performed very easily by any one. Ask the person on whom the experiment is tried, or the observer as we may call him, to close his eyes, and then let the experimenter make some sort of snapping sound (snapping the fingers or snapping with a card will produce suitable sounds) just in front of the middle of the observer's face or just behind the middle of the back of his head. You will find that the observer will make the greatest mistakes in trying to tell where the sound came from. Sometimes when it is in front of him he will tell you it is behind him, and vice versa. In other words, for sounds which are thus half-way between the two ears, there is no means of distinguishing easily the difference between what is in front and what behind. Now let the experimenter move his hand in making the snapping sound slightly to the right or left of the middle line, and it will be found that the observer can give much more accurate localizations—that is, the moment the sound is stronger in one ear than it is in the other, the observer has a complex experience which makes it possible for him to make a comparison and to understand his impressions. The two ears coöperate in these latter cases, in that one reports the sound with a greater intensity than does the other, and by this means the observer recognizes that the sound is on the side of the greater intensity.

"We make use of the same principle in ordinary life. When one wishes to locate a sound, he moves his head around in this direction and in that until finally he gets a different impression in the two ears, and then he can locate the source of the sound on the side of the stronger impression. It is probably true that the difference in the way in which the sound gets into the two ears is also of importance, but our discussion need not go into further detail. You see that, after all, there is some necessity in ordinary hearing for the use of both ears, at least, if we are to know accurately where the source of the sound is located.

"Similar facts can be demonstrated for the eyes. Most of us believe that the world looks the same when viewed with one eye closed as it does when viewed with both eyes open. A simple experiment will convince you that one-eyed vision is less complete than two-eyed vision. Close one eye. Hold up some small object directly in front of the open eye—a pencil or one of your fingers will do; or it will be better yet if you will let some

one else hold something in front of you. Now raise your right hand above your head so that it is out of your range of vision, and rapidly bring it straight down, trying to place the end of your index-finger on the end of the object. After you have brought the finger down and failed to touch the object, open the closed eye and see how clearly the mistaken positions of finger and object are seen with two eyes. One who has tried this experiment a number of times will never be in any doubt as to the fundamental value of two eyes. With two eyes we see the position of objects in depth clearly and vividly; with one eye a great part of this recognition of depth is lost. If you once get into the habit of observing this difference, you can notice it in a great variety of cases. Close one eye and look at a distant group of trees, at a house, or at some object in the room, as a chair, and notice how flat they all look. The best instant at which to notice this flatness is just at the moment when you open the closed eye and see the object fairly leap into depth.

"This difference between one-eyed vision and two-eyed vision is due to the fact that the two eyes get different views of any object at which they look. With the right eye you see a little farther around the right side of the object, and with the left eye you see farther around the left side of the object. The result is that the image in one eye is different from the image in the other eye. Our idea of depth depends on this difference. This is very neatly illustrated in the common instrument with which you are doubtless acquainted, namely, the stereoscope. You will recall that there are always two pictures to look at. These two pictures are mounted in such a way that one is seen with the right eye, the other with the left. You may not have noticed it, but the two pictures, the one on the right and the one on the left, are different. One picture shows a little more of the left side of objects, while the other shows a little more of the right side. If it were not for this difference and for the fact that this difference is now preserved for your vision, in that you look at the one picture into one eye, and the other picture into the other eye—I say if it were not for this difference in the two photographs, you could not see the solidity which is the charm of stereoscopic pictures.

"The question which arises at once after one has been shown by these experiments the importance of two-eyed vision is, Why

is it, that when we close one eye, things are not ordinarily recognized as unusually flat? The answer to this question is to be found in the statement that in ordinary one-eyed vision which is not subjected to close examination, we get the meaning of what we see by the aid of past experiences. We do not see things flattened out as they really are presented to the single eye, but we see beyond the flatness and understand what the objects would be if we saw them with both eyes. In other words, we have become so accustomed to our full two-eyed form of interpretation that, even though only half the usual amount of visual experience is present, we turn it into the usual mold of complete interpretation. In doing this we are aided by the familiarity of the objects and by our knowledge of their surroundings. If we prepare groups of relatively strange objects in a wholly unknown order, as we can easily do by passing threads backward and forward at different levels in a box, then one-eyed recognition of depth becomes almost or quite impossible.

"'But,' some one will probably ask, 'how is it that we never recognize in ordinary life what impressions are coming in at the one eye or the other, and at the one ear or the other? If it is true that the two organs of sense in each case are of such importance, why do we need to make this careful study to find it out?' If you will get the true answer to these questions, you will have one of the important facts in regard to your own mental lives. The fact is that we do not pay attention to sense impressions themselves; we pay attention to sense impressions for the sake of understanding their meanings. Now, the differences in auditory intensity which come to us through the two ears, are of no interest as mere facts of intensity, but they are rich with meaning; and that meaning is what we have learned to recognize. Intensities mean, in such cases, position in space. In the same way the different views of objects which we get in the two eyes, are of no interest as different views, but they are of great interest in their meaning, for the meaning of these differences is solidity and depth. The solidity and depth is what we see, for at our advanced stage of mental development we attend to the meaning only, and neglect entirely the simple fact of sensory differences from which we derive the meaning."

Recognition of Word Meanings. "Mental life is made up in a very large measure of these processes of getting behind ex-

periences and grasping meanings. Take, for example, our recognition of a word. A word taken as a mere sound is a very meager experience. Take such a sound as 'cold.' Pay attention to it as a sound. It is hard and guttural. There is nothing attractive about it; taken all in all, as a mere sound, it promises little for any one's thinking. Imagine yourself a foreigner, unacquainted with all the fulness of meaning that we put into the word because we understand it, and you will recognize what we are trying to emphasize when we say that our mental states are not bound down to present impressions, but are constantly reaching out, and are attaching to the impressions a rich fund of interpretation.

"Or take another illustration. What is a coin to the intelligent adult? Is it a bit of metal with certain decorations? As a matter of ordinary experience, you know how little attention we usually pay to the decorations. It is a commonplace form of amusement to try to see how little most people know about what is on coins. Greenbacks are overlooked in the matter of appearance, even more than coins. Our memory of the size of a common greenback is very defective. But when it comes to meaning, we all have a clear realization of the meaning of currency. We know that there is a certain additional fact behind the mere appearance of the coin or the greenback, which additional fact we call value. Value is the power to bring us desirable things through exchange. This understanding of value is not present in the child's mind, for the child has had no experience on which to base recognition of meanings. He is engrossed in the bright hard metal. Not so with us. We receive the impression, to be sure, but we do not linger even for a moment on the impression. Our attention is upon the remoter significance. Just as we see solidity in ordinary one-eyed vision, which is in reality flat and meager in content, so here in the bit of silver, we realize the possibilities of new experiences not revealed at the moment.

"Mental life is full of illustrations of this type. Indeed, so constantly do we attend to meanings instead of to the real mental states that it is for the most part impossible for us to separate the two. When we look away across the landscape, for example, and see the distant green fields, we are having an experience in which the present impression and its meaning are

very closely woven together. As a matter of immediate vision, the color which the eye receives from those distant so-called green fields, is a very dark bluish green—indeed, in some cases it may even be distinctly blue; but we do not ordinarily notice that. We have come, through past experience, to know that colors grow darker and milder in tone, as their sources are more and more removed from us, and so we think of the distant blue-green, not as it looks, but as it means. There where the grass is growing it is bright green, and the patch of color in our landscape, which is not bright green, means that grass, and we understand it. We see in our mind's eye the meaning, rather than the present shade of the color. One can convince himself that he has gone far beyond present experience in such a case by pulling up a handful of grass and holding it in the line of vision, and thus helping himself by contrasting the two experiences of color to discover what is the real color of the remote field. Or by examination of some landscape painting, you may convince yourself that the artists have known this fact about colors for a long time. If they wish to bring up in your mind a distant object of any kind, they tone down its colors and darken the shade, and you see it, not as mere color but as alive with meaning."

Illusions. "Perhaps some of the best illustrations with which to make clear this fact that we fill out all our lives with meanings, are the illustrations in which we find men attaching the wrong meaning to experiences. One walks out on a dark night and sees the fleeting, shifting darks and shades. What infinite possibility of ghostly interpretation if one is only disposed to read meanings into what he sees! Indeed, I think much of the mystery which men have been wont to read into their environments may well be dwelt upon as showing how much of harm as well as of good may be accomplished by this habit of ours of looking for the meanings beyond our impressions. . . ."

Applications to teaching. "Do not fail to keep in mind the general fact which all of these examples are intended to illustrate. The general fact is that the character of any mental process depends, not merely upon the immediately present factors, but also, and very largely, upon what one sees beyond the given factors as the remoter meaning. This fact that we add meaning to all of our experiences is one of special importance

to our teacher-study. It is very easy to overlook it from the point of view of ordinary experience. The common man wishes to gain complete knowledge of any object. This he desires without particular reference to the question of what is presented and what is seen as meaning. Now and then, in certain exceptional cases, even the ordinary man becomes interested in the difference between presented facts and interpretation. This is the case when he has to sit on a jury and compare the testimony of two or more witnesses for the purpose of discovering exactly what it was that presented itself to the eyes of each observer, and what each added in the way of perfectly honest private interpretation of meaning. In such a case the ordinary man is, like ourselves, interested in the question of meaning versus impression.

"The teacher's interest is not quite the same as that of the juror, but is very closely related to it. The teacher wants to know what parts of a given experience which he and the child are having at a given stage in any study, are really common to both. If he could sharply distinguish in his own experience that which is added meaning from that which is immediately presented impression, he would be better able to understand that he and the child may be looking at the same object, and yet be having vastly different experiences.

"The illustration that comes first to mind is, of course, the illustration of the new word. I remember the first time I heard the words *Ornithorhynchus paradoxus.* They were spoken by a teacher who knew what they meant, and his whole thought was doubtless off in Australia, where there is an interesting animal bearing that name. What was my state of mind? The name had a sort of impressive sound for me, which I dare say my teacher was not noticing at all. I thought that name over as a kind of mouth-filling combination of rather melodious noises and nothing more. My teacher and I were in the presence of the same experience, so far as the immediately given factors were concerned, but he had the meaning, and I had only the sound.

"It is not merely words, however, as common as they are in our school life, which illustrate the absence of meaning on the one side and its presence on the other. Did you ever go with some intelligent teacher of anatomy to examine his museum?

Did you ever notice how every ugly bone and jar grows eloquent with interest when he begins to let you into the secrets of what he sees in those specimens? And did you ever note by contrast how barren and commonplace a museum is when you are left to wander about by yourself, with your ideas tied down to the little that can be seen in the merely present fact?"

Education as Profiting by Past Experience. "The ability to add meanings to impressions is always a mark of extended experience. The teacher differs from the pupil in the larger degree of ability to see meaning in the objects about him. The expert has a greater range of interpretation than has the novice. Everywhere, richer meanings grow up with fuller experiences. One may almost define what we have been calling the meaning of impressions by saying that these meanings are past experiences brought over into the present. Thus, when one sees a dark blue on the distant horizon and knows that it means a green field, this recognition of meaning is due to the fact that on some previous occasion a dark color has grown brighter and lighter as one has walked toward it. In other words, the present impression has meaning because in some past time we discovered the meaning of a similar impression. The richness of present interpretations will, accordingly, depend on the degree in which one has profited by past experiences, and there is a very large justification for the statement that education consists in the process of adding meanings to given impressions.

"Such a definition of education as that which has been offered, requires some further explanation before it can be accepted as entirely safe. Not all meanings are desirable additions to present impressions. Thus, when the savage learns that an eclipse means the wrath of some avenging deity, he has doubtless, in one sense of the word, had an enlargement of experience, but he has hardly been improved, or even educated, in the best sense of the word. What he needs for his education is not merely the addition of meaning to his impression, but the addition of a correct and productive meaning. And just here is the indefinitely large problem: What meanings are correct and productive as additions to given impressions? Here is the serious side of the teacher's task. Be sure, as you face your pupils with a new impression, that they will soon attach some meaning to it. Your problem is to find out what the impression is, and what

is the appropriate meaning. Your next problem is to discover what conditions are most favorable to the establishment of proper meanings, instead of false meanings, in the minds of these pupils. And, finally, your constant task must be to discover what meanings are growing fixed in your pupils' thoughts, and to guard most jealously these growing processes, and by constant supervision to see to it that only productive meanings grow undisturbed.

"Since this matter of the meanings which are attached to impressions is of such importance for our scientific study of the teacher and the teacher's work, it is worth while for us to dwell upon the nature of these added meanings at some length. And the lesson which one must learn at the very outset of this study and must keep in mind all along, is the lesson which has already been taught by our examples, but can never be too fully emphasized, namely, the lesson that it is one of the most difficult tasks in the world to know in any given case what is meaning and what is impression."

Attitudes from Forgotten Experiences. "There are certain cases in which impression and added factors are sufficiently separate so that any one can easily discern both of them. Thus, we have all had the experience of meeting some person whom we have met once or twice before and whom we have nearly forgotten. We have to search in the remote corners of our minds for some stray fact which will guide us in what to say and how to treat the person. Perhaps the earlier experience was agreeable, and with a faint recollection of that in mind, we try now to renew the pleasant relations. We are all the time very conscious of the fact that past experiences are being revived to aid us in understanding and dealing with the present. In other words, we are conscious of the fact that the interpreting meanings which should come out of the past and illuminate the present, are separate from the immediate impression. We recognize in our effort to remember, that the process of finding some of the remoter meanings of the face and voice are different from the immediate impressions.

"Turn from this stranger to your familiar friend. To be sure, the present impression is again nothing but a face and a voice; but these are now no meaningless visual and auditory impressions. The face and the voice are full of rich significance.

You know just how to act, and you have that comfortable feeling of familiarity that comes from a clear and full knowledge of the meaning of your impression. The meaning comes so easily in this case that we do not think of it as separate from the impression. We do not say that we remember our intimate friends —we say that we recognize them, thereby indicating that in this case meaning and impressions arise together. To be sure, the meaning never could have appeared if it had not grown up in the past experience, but at this stage of development it is not referred back to the past at all. It is not a memory, it is a present fact. Let us call it a present meaning, in order to distinguish it from something remembered and dragged into the present out of the past. Present meaning and memory are, then, two different forms in which experience gets itself added to present impressions. Memory is the more obvious case of enlarging upon our impressions: present meaning is the more common and the more important case.

"Let me impress upon you the difference between present meaning and memory by means of an illustration which was furnished to me by a friend. He feels a very strong dislike for horses. He can not bear to come near a horse's head. This is, as you readily see, a way of looking at the horse which differs radically from the way in which most of us look at that animal. My friend's interpretation is that the animal is harmful, to be avoided, and thoroughly disagreeable. For a long time, he said, this peculiar personal attribute toward horses remained a mystery to him. No memory served to show him how he had acquired this sort of a present meaning. He knew he differed from most people whom he saw liking horses, but that was not enough to dissuade him from his view; for him horses were and are thoroughly distasteful factors of experience. He confided his feelings to an uncle one day, and received from the uncle information which cleared up the whole matter. When he was a boy he had been bitten by a horse. That experience had left its mark on his future interpretations of horse nature, not in the form of memory, for the incident was entirely forgotten, but in the form of a thoroughly established meaning. To-day he looks at horses as that experience led him to know horses; but all he has carried away for his mental life is the meaning of the event, not the actual memory image.

"Each of us has had similar experiences, though perhaps less clearly defined. Have you never taken a strong dislike to some one you have just met? Have you not read into his face or manners all sorts of disagreeable traits? And then have you not suddenly realized, as an explanation of the whole interpretation in which you have been indulging, that this man looks like some one you knew in the past? In other words, you have been disliking him because your experience has been such that those special features which he exhibits, mean something unpleasant to you. Notice that in such a case your recognition of present meaning could not depend on memory, for the memory came after the interpretation. The meaning is explained by your recalling after a time some special face in your past experience which has helped to establish the meaning, but the interpretation was something different from the explanation afforded by memory. The interpretation is immediate and definite; memory follows in such a case far behind. If there are cases in which tardy memory arrives to explain our sudden interpretations, how many cases are there, do you suppose, in which the interpretation goes forward in the same way but is not explained at all? I think a careful analysis of experience would go to show that our lives are made up of interpretations that are so settled and fixed that the memory factors which would explain them are long since dispensed with."

Past Experiences and Memory. "Our minds are thus constantly seeing in present impressions their meanings. These meanings are the results of past experiences, but they do not depend in any great number of cases on any clearly recognized reference to remembered experiences. You look into a mirror, for example, and you are performing an act of double interpretation. In the first place, you see the object straight ahead of you, back of the mirror. This experience is due to a fixed mode of interpreting experiences which if formulated would lead to a statement of the general principle: light has traveled in straight lines in a sufficiently large number of past experiences so that one is safe in interpreting present cases in the belief that it is always true that light travels in this way. It is hardly necessary to point out that no one ever does, in ordinary life, formulate such a principle as the basis of locating objects in mirrors. Indeed, no one ever thinks about his past experiences in any ex-

plicit way. Past experiences have been boiled down into a very safe and practical habit of interpretation. We see objects straight ahead. But now notice the interesting fact that our interpretations of objects seen in mirrors goes further than this. We have, as I said a moment ago, a double interpretation. If we see the frame of the mirror, or if we recognize the presence of the mirror in any way, we know enough about mirrors to interpret our mirror object as a reflection, not a real object. We interpret the light as coming from what we know through experience to be an image rather than a thing. A savage does not have this added experience which enables us to interpret our experiences in mirrors as images. He takes the image for a real object. We do the same when we fail to notice the mirror. In both these latter cases the interpretation is not double; it is simple and based on the more common fact that in all our past experience light comes in straight lines and from real objects.

"I hope these illustrations have made it clear to you that present meanings are not identical with memories. Our way of looking at things is indeed the product of past experiences, but past experiences are not reproduced in full in the vast majority of our interpretations. Past experiences are worked over, epitomized, condensed, or whatever you please to call it, if you will only recognize that our modes of getting at present meanings are wonderfully economical means of guiding us. They bring all the past into our present lives, sifted and arranged for immediate use.

"Indeed, if you will consider carefully you will see that such condensation is just as important a condition for progress as retention. Suppose every time we were confronted with an impression, we had to go through a long process of passing in review in memory all the related facts out of our past. We should never progress. It is because we do not have to carry the useless parts of this past into the future, because we have the power of selecting and appropriating what we need, that we can profit by past experiences without being burdened with the experiences in full. . . ."

"When we compare memory and present meaning, we find that present meaning is usually the result of more extended development than is found in cases of memory. Thus in the illustration which we used some time ago, of the mental proc-

esses which arise in the cases of meeting a comparatively new acquaintance and of meeting a familiar friend, memory is evidently drawn upon in the case of the new acquaintance, because sufficient experience for direct interpretation is not yet acquired. So also in learning new words. One has to go through the memory period in order to reach the interpretation period. This is especially obvious when one tries to learn a foreign language. One finds it necessary to stop and think of meanings, to recall slowly and laboriously what he has learned. In later, fuller acquaintance with words, one will become freer and freer from the necessity of remembering. Spencer has stated this fact in regard to memory and interpretation very clearly in his *Principles of Psychology,* where he writes: 'Memory,* then, pertains to that class of psychical states which are in process of being organized. It continues so long as the organization of them continues, and disappears when the organization of them is complete.'

"One might spend a long time dwelling upon the importance of this statement of Spencer for educational practice. If it be true that memory is a stage of incomplete mental development, that there is a higher and more perfect form of organization beyond memory, then the fact must be recognized as important for school work. Certain it is that school work has no right to stop when it has trained memory. It must go on to the higher stage, which we have called recognition of present meanings."

Training through Use. "There is, however, a much more significant question about the relation between memory and interpretation than this which we have answered by saying with Spencer, that memory, when it is present, is an incomplete phase of development. The question which our present-day education is most eagerly asking is this, How far is there any real need of memory in giving present meanings? May we not pass to present meanings, it is asked, with much greater directness? Some of us are not asking this question in words, perhaps, but we are asking it in a practical way when we try to reduce to a minimum the memory work in our daily teaching of children. Can we get along with less memory, asks another teacher, when he says that he would rather develop power in his pupils to deal

* Spencer, Herbert, *Principles of Psychology.* By permission of D. Appleton & Company.

with experiences as they rise, than cultivate memory of any number of facts which can not be put into immediate use. And so on through the whole list of modern educational reforms, we find this question of memory versus direct interpretation, one of the most vital questions in all our thinking and teaching.

"It is a question which certainly deserves discussion from the point of view of the teacher's own mental life as well as from the point of view of the teacher's work. How much of our training in methods of teaching, for example, do we owe to memory, and how much do we owe to what we like to call tact or spontaneous power of dealing with situations when they arise? I hardly need to remind you that the common answer to this question in regard to the training of teachers is, like the common answer to the question in regard to the training of children, much in favor of direct ability to interpret and control rather than in favor of memory. So from all points we come to the question, How can direct interpretation be gained with the least possible delay, with the least lingering at the lower level of memory?

"There need be no hesitation in giving the answer to this question. The amount of memory drill necessary in order to secure immediate interpretation is reduced just in the ratio in which practical and immediate contact with impressions is increased. Direct handling is the great means of training by which we can obviate the necessity of memory work. The method of learning what things are by using them, is so distinctly the modern method of learning that we all understand its cardinal virtues. Some of the games which we learn almost entirely by practice, and hardly at all by precept, are perhaps the best illustrations of the avoidance of memory work in adult education. If one wants to learn tennis, for example, he commonly goes out and tries to hit the ball. When he succeeds, it is due to the fact that he has tried a variety of ways of reaching the ball and has finally found the right response to his present impression. Success is in a measure the result of past failures, and certainly each success will lead to a higher level of proficiency in the future. But one does not remember in any great degree these various experiences which perfect his ability as a tennis player. He just keeps on trying, each time coming a lit-

tle nearer to what he regards as a satisfactory degree of proficiency. Again, consider the experience of learning to ride a bicycle, which is much like that of playing tennis. Other examples are, learning to swim, learning some trick of manual dexterity, such as tying a complex knot. In all these cases one learns by trying. Each experience is incorporated at once into present meaning, the useless parts of the experience being dropped on the spot, and only that which is thoroughly assimilated being carried away. That is, if the trial is not successful it is rejected, and just in so far as it is successful it is retained as a present mode of acting in a given situation. The last and most successful movement is recorded in such cases, not in memory images, but in the form of an acquired habit.

"Memory is not needed in the cases we have been discussing, because memory would carry forward too much. If memory shows itself at all in such cases, it is usually in the very undesirable form of a haunting recollection of some disastrous failure, which contributed to education only in the most remote and negative way. That the final successful movements are not retained in memory, you can make yourself realize by trying to tell somebody else how you performed the successful move. For example, try to explain how you tie a knot, and see how little is retained in memory. On the other hand, the habit never fails, in spite of your inability to recall how you acted the last time and the time before. In the presence of proper conditions of string and free ends you feel that 'warmth and familiarity' of experience which marks it in your mind as an experience which you can easily and directly interpret and manage.

"One can avoid memory work through training in the use of things. This is the observation which experience forces upon us at all points, and this is the principle that our modern education is so eagerly taking up in all departments—in the kindergarten, in the constructive work of the elementary schools, in the manual training and in the laboratory work of our high schools and colleges. Learn by use, learn by doing, and you shall have followed the shortest route to recognition of present, practical meanings."

[Judd, C. H., *Genetic Psychology for Teachers* (D. Appleton and Company, New York, 1903), pp. 36–43, 46–53, 55–56, 58–62. By permission.]

2. CHANGES NEEDED IN AMERICAN SECONDARY EDUCATION

Rôle of Observation in Obtaining Knowledge. "The best part of all human knowledge has come by exact and studied observation made through the senses of sight, hearing, taste, smell, and touch. The most important part of education has always been the training of the senses through which that best part of knowledge comes. This training has two precious results in the individual, besides the faculty of accurate observation—one the acquisition of some sort of skill; the other the habit of careful reflection and measured reasoning which results in precise statement and record.

"A baby's assiduity in observation and experimentation and the rapidity of its progress in sense-training are probably never matched in after life.

"The boy on a farm has admirable opportunities to train eye, ear, and hand, because he can always be looking at the sky and the soils, the woods, the crops and the forests, having familiar intercourse with many domestic animals, using various tools, listening to the innumerable sweet sounds which wind, water, birds, and insects make on the countryside, and in his holidays hunting, fishing, and roaming.

"The fundamental trades, such as those of the carpenter, mason, blacksmith, wheelwright, painter, hand leatherworker, and shoemaker, have provided immensely valuable education for the human race, and have, indeed, been the chief means of raising barbarous peoples to a condition of approximate civilization. To-day, the teaching of those trades, without much use of machinery, is the best mode of developing the natural powers of a backward people.

"In noble and rich families some training of the senses was obtained all through feudal times; because the men were brought up to war and the chase, and the women not only shared in some degree the sports of the men, but acquired the manual skill which sewing, knitting, hand-weaving, and embroidering demand.

"The advent of mechanical power and machinery has greatly impaired the educational value of many trades, and this impairment has become so common that it may almost be called universal. The accurate joints a carpenter used to make by the

careful use of his own eyes and hands are now made by machines almost without human intervention. The horseshoe which a blacksmith used to turn by hand on his anvil, and temper in his own little fire with a very accurate appreciation of the changing tints of the hot metal, is now turned out by machinery as one of a hundred thousand, almost without touch of human hand or glance of human eye. The ordinary uniformity of a machine product is due to invariability in the action of the machine, and this invariability is a main object from the point of view of the inventor or the proprietor; but that same invariability makes the tending of the machine of little use in the education of the human being that tends it—child, woman, or man.

"The difference between a good workman and a poor one in agriculture, mining, or manufacturing is the difference between the man who possesses well-trained senses and good judgment in using them and the man who does not."

Sense-Training Neglected. "It follows from these considerations that the training of the senses should always have been a prime object in human education, at every stage from primary to professional. That prime object it has never been, and is not to-day. The kind of education the modern world has inherited from ancient times was based chiefly on literature. Its principal materials, besides some elementary mathematics, were sacred and profane writings, both prose and poetry, including descriptive narration, history, philosophy, and religion; but accompanying this tradition of language and literature was another highly useful transmission from ancient times—the study of the fine arts, with the many kinds of skill that are indispensable to artistic creation. Wherever in Europe the cultivation of the fine arts has survived in vigor, there the varied skill of the artist in music, painting, sculpture, and architecture has been a saving element in national education, although it affected strongly only a limited number of persons. The English nation was less influenced by artistic culture than the nations of the Continent. American secondary and higher education copied English models, and were also injuriously affected by the Puritan, Genevan, Scotch-Presbyterian, and Quaker disdain for the fine arts. As a result the programs of secondary schools in the United States allotted only an insignificant portion of school time to the cultivation of the senses through music and drawing; and, until

lately, boys and girls in secondary schools did not have their attention directed to the fine arts by any outside or voluntary organizations. As a rule, the young men admitted to American colleges can neither draw nor sing; and they possess no other skill of eye, ear, or hand."

Progress of Science. "Since the middle of the eighteenth century, a new element in the education of the white race has been developing, slowly for a hundred years, but rapidly during the past fifty. This new element is physical, chemical, and biological science. Through the study of these subjects the medical profession has been revolutionized, and several new professions of high value have been created, such as that of the chemist, or the engineer—civil, mechanical, electrical, or metallurgical—and of the forester. Through the radical work of great inventors and discoverers and of these new professions, all the large industries and transportation methods of the world, and therefore the commerce of the world, have been so changed that the producers and traders of times preceding 1850 would find, if they should revisit the scenes of their labors, that the processes by which they made their livings had completely disappeared. This prodigious change should have instructed the makers of programs for schools and colleges maintained by nations which were undergoing this great revolution in regard to their means of livelihood; but for the most part professional educators have been, and still are, blind to the necessity of a corresponding reformation or revision of the processes of education."

Training in Medicine Better Than in Other Fields. "There is one profession, however, in which the educational processes have been adequately changed, but only within recent years, namely, the profession of medicine. The reason for the comparatively early improvement of medical education is that the medical art has always depended, for such measures of success as it attained, on the physician's power of accurate observation and his faculty of reasoning cautiously and soundly on the testimony which his senses gave him. From remotest times the successful physician has been by nature a naturalist. He saw and heard straight, and his touch gave him trustworthy information. He has still, and must always have, the naturalist's temperament, and he must possess the naturalist's trained senses. The reason that medicine and surgery have within 25 years

made such astonishing progress is that the practitioner, possessing the senses and mental habits of the naturalist, has been supplied through the progress of biological, chemical, and physical science with wonderful new means of accurate diagnosis. The training the medical student now receives is very largely individual training in the use of his senses; and this training is given by experts in the use of their own eyes, ears, and hands in diagnosis and treatment. The just reasoning follows on the trustworthy observation. What has already been done in medical education needs to be done in all other forms of education, whether for trades or for professions, whether for occupations chiefly manual or for those chiefly mental.

"The great increase of urban population at the expense of rural which has taken place during the past 60 years, with the accompanying growth of factories, and the crowding together of the working people and their families, has resulted, so far as schools and colleges are concerned, in placing more children and youths than formerly under the influence of systematic education and keeping them there for a longer period; but this improvement has been accompanied by a decline in the amount and quality of the sense training which children and adolescents have received. In cities and large towns the trade which a boy chooses or is assigned to no longer demands for admission a prolonged apprenticeship. Machinery turns out an ample product, without the need of much skilled labor. The general result is an inadequate training of the senses of the rising generation for accurate and quick observation."

Human Testimony Untrustworthy. "In recent years, on account of the complexities, urgencies, and numerous accidents of urban life, there has been a striking revelation of the untrustworthiness of human testimony, not because the witnesses intended to deceive, but because they were unable to see, hear, or describe accurately what really happened in their presence. This inability to see, hear, and describe correctly is not at all confined to uneducated people. On the contrary, it is often found in men and women whose education has been prolonged and thorough, but never contained any significant element of sense training. Many highly educated American ministers, lawyers, and teachers have never received any scientific training, have never used any instrument of precision, possess no manual skill

whatever, and can not draw, sing, or play on a musical instrument. Their entire education has dwelt in the region of language, literature, philosophy, and history, with a brief excursion into the field of mathematics. Many an elderly professional man, looking back on his education and examining his own habits of thought and of expression, perceives that his senses were never trained to act with precision; that his habits of thought permit vagueness, obscurity, and inaccuracy, and that his spoken or written statement lacks that measured, cautious, candid, simple quality which the scientific spirit fosters and inculcates.

"A survey of the programs of the existing American secondary schools—public, private, and endowed—would show that, as a rule, they pay little attention to the training of the senses, and provide small opportunities for acquiring any skill of eye, ear, or hand, or any acquaintance with the accurate recording and cautious reasoning which modern science prescribes. The general result of such a survey would be that the secondary schools are giving not more than one-tenth to one-sixth of their force to observational, sense-training subjects. Any school superintendent, teacher, or committee man can verify the results of this analysis in any secondary schools with which he is acquainted."

Suggested Changes in Curriculum. "The changes which ought to be made immediately in the programs of American secondary schools, in order to correct the glaring deficiencies of the present programs, are chiefly the introduction of more hand, ear, and eye work, such as drawing, carpentry, turning, music, sewing, and cooking; and the giving of much more time to the sciences of observation—chemistry, physics, biology, and geography, not political, but geological and ethnographical geography. These sciences should be taught in the most concrete manner possible —that is, in laboratories, with ample experimenting done by the individual pupil with his own eyes and hands, and in the field through the pupil's own observation guided by expert leaders. In secondary schools situated in the country the elements of agriculture should have an important place in the program, and the pupils should all work in the school gardens and experimental plats, both individually and in coöperation with others. In city schools a manual training should be given which should

prepare a boy for any one of many different trades, not by familiarizing him with the details of actual work in any trade, but by giving him an all-round bodily vigor, a nervous system capable of multiform coördinated efforts, a liking for doing his best in competition with mates, and a widely applicable skill of eye and hand. Again, music should be given a substantial place in the program of every secondary school, in order that all the pupils may learn musical notation, and may get much practice in reading music and in singing. Drawing, both freehand and mechanical, should be given ample time in every secondary school program; because it is an admirable mode of expression which supplements language and is often to be preferred to it, lies at the foundation of excellence in many arts and trades, affords simultaneously good training for both eye and hand, and gives much enjoyment throughout life to the possessor of even a moderate amount of skill.

"Drawing and music, like other fine-art studies, were regarded by the Puritan settlers of New England and by all their social and religious kindred as superfluities, which, if not positively evil, were still of wasteful or harmful tendency, and were, therefore, to be kept out of every course of education. By many teachers and educational administrators music and drawing are still regarded as fads or trivial accomplishments not worthy to rank as substantial educational material; whereas they are important features in the outfit of every human being who means to be cultivated, efficient, and rationally happy. In consequence, many native Americans have grown up without musical faculty and without any power to draw or sketch, and so without the high capacity for enjoyment, and for giving joy, which even a moderate acquaintance with these arts imparts. This is a disaster which has much diminished the happiness of the native American stock. It is high time that the American school—urban or rural; mechanical, commercial, or classical; public, private, or endowed—set earnestly to work to repair this great loss and damage. Although considerable improvements have been recently made in the programs of American secondary schools, especially within the past 10 years, or since vocational training has been much discussed, multitudes of Americans continue to regard the sense training subjects as fads and superfluities. They say, let the public elementary schools teach

thoroughly reading, writing, spelling, and arithmetic, and let natural science, drawing, music, domestic arts and crafts, and manual training severely alone. Let the secondary schools teach thoroughly English, Latin, American history, and mathematics, with a dash of economics and civics, and cease to encumber their programs with bits of the new sciences and the new sociology. This doctrine is dangerously conservative; for it would restrict the rising generations to memory studies, and give them no real acquaintance with the sciences and arts which within a hundred years have revolutionized all the industries of the white race, modified profoundly all the political and ethical conceptions of the freedom-loving peoples, and added wonderfully to the productive capacity of Europe and America.

"If anyone asks how it can be possible that these new subjects, all time-consuming, should be introduced into the existing secondary schools of the United States, the answer—adequate, though not easy to put into practice—is, first, that the memory subjects and the mathematics should be somewhat reduced as regards number of assigned periods in the week; secondly, that afternoon hours should be utilized, or, in other words, that the school day should be lengthened; and thirdly, that the long summer vacation should be reduced. It is worse than absurd to turn city children into the streets for more than two months every summer. Since the new subjects all require bodily as well as mental exertion, they can be added to the memory subjects without any risk to the health of the children, provided that the shops, laboratories, and exercising rooms be kept cool and well ventilated. In rural schools a good part of the new work in sowing, planting, cultivating the ground, and harvesting must be done out-of-doors. The observational, manual, and scientific subjects often awaken in a boy or young man for the first time an intellectual interest and a zeal in work which memory studies have never stirred. Hand-and-eye-work often develops a power of concentrated attention which book-work had failed to produce, but which can be transferred to book-work when once created. All the new subjects require vigorous and constant use of the memory, and give much practice in exact recording, and in drawing only the limited and legitimate inference from the recorded facts.

"The suggested changes in American school programs will not make public school life harder or more fatiguing for the pupils. On the contrary, observational study and concrete teaching are more interesting to both children and adults than memory study of any sort; and whenever the interest of pupils is aroused, it brings out more concentrated attention and harder work, but causes less fatigue. The obvious utility of mental labor directed to a practical end increases the interest the pupils take in their work, and stimulates them to effective effort. To use a good tool or machine and get the results it is competent to produce when in skillful hands, is vastly more interesting than reading or hearing about the uses of such a tool or machine. Whenever, by the use of observational and concrete methods, the pupils' power of attention and of concentrated effort is developed, that power of attention once acquired can be exercised in other subjects. This principle holds true not only of manual or bodily labor but also of games and sports, and of cooperation in rhythmical movements, like dancing. The power of concentrated attention won in carpentry, turning, forging, or farm work is easily transferred to work in reading, writing, and ciphering, or at a later stage in history, literature, and civics; so that the reduction in the so-called academic studies made to allow the introduction of observational studies need not result in less attainment in the academic studies themselves."

[Eliot, C. W., "Changes Needed in Secondary Education," United States Bureau of Education, Bulletin No. 10, 1916, pp. 5–11.]

3. ADVANTAGES AND DISADVANTAGES OF HABIT

"Provided an activity is one that will be frequently required to be performed, it is advantageous to make it habitual; for it will then be performed with greater ease, greater speed, and greater precision. Making activities habitual has the additional advantage of freeing consciousness so that it may be used in connection with the acquiring of other activities which have not yet become habitual, and which perhaps because of their nature should never become habits. For example, were it not for the fact that habits have been formed of making writing move-

ments, we should be unable to concentrate our attention on the meaning of the words we wish to express.

"While habit is in the main advantageous, one may become the slave of habit. Slavery to habit occurs when one is unable to change a certain form of behavior if there is good reason that one should do so. The reason for changing may be either that the habit is morally bad or practically inefficient, or that conditions have been so changed as to make change in behavior desirable. Persons who are not able to change their habits of thought or action when it would be advantageous to do so are not easily adaptable to new situations, and cannot readily change their opinions even though the evidence may require it.

"In view of the fixed tendency which everybody has to become more and more fixed in his habits as he becomes older, it becomes the more necessary that habits should be formed, when young, of such a kind as to be useful throughout life. The best time for the formation of useful, practical habits is probably the period from eight to twelve years in the child's life. This is the period of drill in all the processes that constitute the tools of learning, and that have to become automatic to be useful, such as reading, writing, and the fundamental processes of arithmetic. This is the time, too, for inculcating habits of correct manners, pronunciation (of one's own and foreign language), as well as habits involving moral qualities like cleanliness, independence, accuracy, honesty, and so forth."

[Cameron, E. H., *Psychology and the School* (The Century Co., New York, 1921), pp. 61–62. By permission.]

The term *habit* is used somewhat loosely in psychology to refer to any learned response, whether of thought, feeling, or action. While the phase of habit that relates itself to perceptual learning would not strictly include habits of thought and feeling, the remaining discussions of this chapter deal with habit in the broadest sense. The extract from the writings of William James * is a classic that should be familiar to every student of education.

4. THE LAWS OF HABIT

"*The Nature of Habit.* . . . The great thing in all education is to make our nervous system our ally instead of our enemy. It is to fund and capitalize our acquisitions, and to live at ease upon the interest of the fund. For this we must make automatic and habitual, as early as possible, as many useful actions as we can, and as carefully guard against the growing into ways that are likely to be disadvantageous. The more of the details of our daily life we can hand over to the effortless custody of automatism, the more our higher powers of mind will be set free for their own proper work. There is no more miserable human being than one in whom nothing is habitual but indecision, and for whom the lighting of every cigar, the drinking of every cup, the time of rising and going to bed every day, and the beginning of every bit of work are subjects of express volitional deliberation. Full half the time of such a man goes into the deciding or regretting of matters which ought to be so ingrained in him as practically not to exist for his consciousness at all. If there be such daily duties not yet ingrained in any one of my hearers, let him begin this very hour to set the matter right."

Maxims for Habit Formation. "In Professor Bain's chapter on 'The Moral Habits' there are some admirable practical remarks laid down. Two great maxims emerge from the treatment. The first is that in the acquisition of a new habit, or the leaving off of an old one, we must take care to launch ourselves with as strong and decided an initiative as possible. Accumulate all the possible circumstances which shall reinforce the right motives; put yourself assiduously in conditions that encourage the new way; make engagements incompatible with the old; take a public pledge, if the case allows; in short, envelope your resolution with every aid you know. This will give your new beginning such a momentum that the temptation to break down will not occur as soon as it otherwise might; and every day during which a breakdown is postponed adds to the chances of its not occurring at all. . . .

"The second maxim is, Never suffer an exception to occur till the new habit is securely rooted in your life. Each lapse is like the letting fall of a ball of string which one is carefully winding up; a single slip undoes more than a great many turns

will wind again. Continuity of training is the great means of making the nervous system act infallibly right. . . .

"A third maxim may be added to the preceding pair: Seize the very first possible opportunity to act on every resolution you make, and on every emotional prompting you may experience in the direction of the habits you aspire to gain. It is not in the moment of their forming, but in the moment of their producing motor effects, that resolves and aspirations communicate with the new 'set' to the brain.

"No matter how full a reservoir of maxims one may possess, and no matter how good one's sentiments may be, if one has not taken advantage of every concrete opportunity to act, one's character may remain entirely unaffected for the better. With good intentions, hell proverbially is paved. This is an obvious consequence of the principles I have laid down. A 'character,' as J. S. Mill says, 'is a completely fashioned will'; and a will, in the sense in which he means it, is an aggregate of tendencies to act in a firm and prompt and definite way upon all the principal emergencies of life. A tendency to act only becomes effectively ingrained in us in proportion to the uninterrupted frequency with which the actions actually occur, and the brain 'grows' to their use. When a resolve or a fine glow of feeling is allowed to evaporate without bearing practical fruit, it is worse than a chance lost: it works so as positively to hinder future resolutions and emotions from taking the normal path of discharge. There is no more contemptible type of human character than that of the nerveless sentimentalist and dreamer, who spends his life in a weltering sea of sensibility, but never does a concrete manly deed.

"This leads to a fourth maxim. Don't preach too much to your pupils or abound in good talk in the abstract. Lie in wait rather for the practical opportunities, be prompt to seize those as they pass, and thus at one operation get your pupils both to think, to feel, and to do. The strokes of behavior are what give the new set to the character, and work the good habits into its organic tissue. Preaching and talking too soon become an ineffectual bore. . . .

"We all intend when young to be all that may become a man, before the destroyer cuts us down. We wish and expect to enjoy poetry always, to grow more and more intelligent about pic-

tures and music, to keep in touch with spiritual and religious ideas, and even not to let the greater philosophic thoughts of our time develop quite beyond our view. We mean all this in youth, I say; and yet in how many middle-aged men and women is such an honest and sanguine expectation fulfilled? Surely, in comparatively few; and the laws of habit show us why. Some interest in each of these things arises in everybody at the proper age; but, if not persistently fed with the appropriate matter, instead of growing into a powerful and necessary habit, it atrophies and dies, choked by the rival interests to which the daily food is given. We make ourselves into Darwins in this negative respect by persistently ignoring the essential practical conditions of our case. We say abstractly: 'I mean to enjoy poetry, and to absorb a lot of it, of course. I fully intend to keep up my love of music, to read the books that shall give new turns to the thought of my time, to keep my higher spiritual side alive, etc.' But we do not attack these things concretely, and we do not begin to-day. We forget that every good that is worth possessing must be paid for in strokes of daily effort. We postpone and postpone, until those smiling possibilities are dead. Whereas ten minutes a day of poetry, of spiritual reading or meditation, and an hour or two a week at music, pictures, or philosophy, provided we began now and suffered no remission, would infallibly give us in due time the fulness of all we desire. By neglecting the necessary concrete labor, by sparing ourselves the little daily tax, we are positively digging the graves of our higher possibilities. This is a point concerning which you teachers might well give a little timely information to your older and more aspiring pupils. . . .

"Could the young but realize how soon they will become mere walking bundles of habits, they would give more heed to their conduct while in the plastic state. We are spinning our own fates, good or evil, and never to be undone. Every smallest stroke of virtue or of vice leaves its never-so-little scar. The drunken Rip Van Winkle, in Jefferson's play, excuses himself for every fresh dereliction by saying, 'I won't count this time!' Well, he may not count it, and a kind Heaven may not count it; but it is being counted none the less. Down among his nerve-cells and fibres the molecules are counting it, registering and storing it up to be used against him when the next temptation comes.

Nothing we ever do is, in strict scientific literalness, wiped out.

"Of course, this has its good side as well as its bad one. As we become permanent drunkards by so many separate drinks, so we become saints in the moral, and authorities and experts in the practical and scientific spheres, by so many separate acts and hours of work. Let no youth have any anxiety about the upshot of his education, whatever the line of it may be. If he keep faithfully busy each hour of the working day, he may safely leave the final result to itself. He can with perfect certainty count on waking up some fine morning to find himself one of the competent ones of his generation, in whatever pursuit he may have singled out."

[James, William, *Talks to Teachers.* By permission of Henry Holt and Company.]

QUESTIONS

1. Explain what Judd means by *consolidations;* by *interpretations* or *meanings.*
2. What pedagogical principles are dependent on this doctrine of meaning?
3. Distinguish between meanings and memories.
4. What rule for economizing effort in memorizing does Judd give?
5. Why does the pupil of to-day need to pay more attention to the training of observation than at an earlier period in our history?
6. What are the psychological grounds for the sorts of changes advocated for the high school by President Eliot?
7. What are the advantages and disadvantages of habit.
8. Is habit "ten times nature" in any proper sense of the word *nature?*
9. State James's maxims for habit formation.

CHAPTER XI

IDEATIONAL LEARNING

The emphasis which has been placed on the importance of development of motor activities in the preceding chapters may have led the student to wonder why so much of the work of schools is concerned with words, both oral and written. The fact is, of course, that ideational learning is almost entirely carried on in terms of words. Furthermore, language itself is a form of motor activity in a much more complete sense than is usually realized.

1. HOW WORDS GET THEIR MEANINGS

Word Meanings Not Dependent on Imagery. "Modern Psychology has come to the conclusion that a very large element in the interpretation of a word is not the image but . . . certain tendencies toward action. In order to emphasize this statement, we may appeal to certain simple cases. If one thinks of such a word as 'up,' one realizes at once that there is a tendency for the whole organism to turn upward. There is a contraction of the muscles of the eyes and even of the trunk in an upward direction. The more vividly the word is experienced, the more emphatic is the muscular response.

"In cases which are less concrete than just described the reaction is of a much more subtle character. When one uses the word 'hate,' for example, there is a muscular contraction somewhere in the interior of the organism. That it is a characteristic contraction will perhaps be most strikingly realized when one contrasts the reaction to the word 'hate' with the muscular contraction of a wholly different sort which follows the use of the word 'admire.'

"*Subtle Character of Interpretative Reactions.* We are not able to describe in all detail the types of muscular reaction which follow the use of particular words. Indeed, it is quite certain that different individuals have their own private methods of

responding to different words. The types of reaction which are exhibited at different stages of personal development are also radically different. The immature individual has a grosser form of response than does the mature individual who has become skillful in the recognition and expression of delicate shades of meaning.

"The particular movement which any given individual makes in interpreting a word is the result of a series of experiences which are peculiar to himself. The first time he heard the word he was in a situation which called forth a certain response. This original response was modified and either enlarged or reduced by a series of subsequent experiences, each of which contributed in its own special way to the final result, which is a distinctly individualistic reaction to the word.

"When one gets this general view of the nature of individual reactions in the presence of words, one realizes why it is that long years of training are necessary before the child secures anything approaching complete mastery of language. Forms of behavior and interpretation must be cultivated for a great number of different expressions, and these expressions must then be put together in various combinations until finally the mastery of continuous discourse becomes possible.

"*The Origin and Evolution of Language.* Studies of mature language together with observations of contemporary primitive languages and of the way in which children acquire their vernacular make it possible to reconstruct a general theory of the origin and evolution of language."

Language and Emotions. "Language has its roots in the simplest forms of spontaneous behavior. The infant makes noises not as a means of communication or as a conscious effort to be social but rather as a spontaneous emotional expression. When the infant cries in early life, it is because stimulations from an excited central nervous system pass down the motor nerves and arouse the vocal cords to action. Such behavior and the resulting sounds are not speech but pure emotional reaction. They are universally accompanied by movements of other parts of the body, such as the arms and legs, which participate freely in early emotional reactions."

Imitation and Language. "In the course of the child's development, emotional expressions of the type just described are trans-

formed from purely individualistic forms of behavior into means of social communications. The first step in this transformation is taken when emotional expressions attract imitation.

"As soon as any emotional expression begins to be imitated by someone else, it takes on an entirely new value, a value which is not purely personal but which belongs to the group. What is meant by this statement can be illustrated by reference to many forms of behavior which are below the level of speech. In a group of animals the running of a single individual may precipitate a stampede. The stampede in this case is a primitive example of social communication. There is usually no intention to communicate involved in cases of the type here described.

"The importance of highly developed forms of imitation appears further in the fact that a modern man does not allow himself to express his emotions freely because the impression which would be produced upon his social environment would be so vivid that he would become responsible for emotional excitement not only within himself but throughout the group. Communication is, to be sure, not of a verbal type in this case but is, nevertheless, a pronounced form of social imitation.

"Very early in life the child begins to realize that the sounds which he is producing have social significance. Furthermore, he finds that the social group around him is constantly producing sounds, and he seeks to share in the activities of the group by producing sounds like those which he hears.

"*Natural Signs.* In the early stages of social communication gestures and facial expressions are quite as impressive in producing social imitation as are activities of the vocal cords. Gestures are made at first as spontaneous individual reactions to one's environment, and later they become, through imitation, means of social communication. Gestures possess certain characteristic virtues as means of expression which do not attach to sounds produced by the vocal apparatus. When a person makes a gesture, he sees himself going through the operation, and he can observe what he does from a point of view very similar to that of another person. The gesture is therefore a very natural means of expressing one's ideas, and it is much used among primitive peoples to attract attention.

"Gesture has another characteristic which justifies the use of the descriptive term 'natural sign.' A gesture in any given

situation is part of the general bodily reaction which the individual would make if there were no one present. The gesture of pointing is nothing more than a reduced form of the tendency to reach for any object that attracts attention. The shaking of the head in an act of negation is a part of the movement of rejecting something. A beckoning gesture is a movement to draw someone toward the person who beckons. All these are natural signs."

Animal Communication. "Animal communication is limited to the forms of imitation which attach to emotional sounds and gestures. If one dog sees another dog running in a certain direction, imitation is quite certain to occur, but the imitating dog will not gain any ideas through what it does. Again, if the first dog begins to bark, the second dog imitates without any explicit knowledge of the motives that prompted the first barking. In other words, animals are drawn into sympathetic behavior by observing their kind, but they do not possess means of elaborate communication of ideas.

"Social communication among animals stops at the point where simple emotional expressions and certain simple direct gestures are imitated. Animals do not have the power to make their acts vehicles for the expression of elaborate processes which can be carried on only by an animal with a large cerebrum. The use which human beings make of imitated sounds and gestures depends on associations of the type described in an earlier paragraph and marks a step upward in the evolutionary scale.

"*Conventional Signs.* Let us see how human beings living in groups evolved language. A primitive group which throughout its early history had secured from sounds and gestures only such advantages as were gained from direct imitation became sufficiently compact so that its members could communicate not only by means of elaborate gestures but also by means of very simple gestures. Such a stage is reached when the group becomes intimate and when each member is supplied with a large cerebrum and consequently with an elaborate storehouse in which experiences can accumulate. Gestures in such a group pass into a stage of development in which they readily call up elaborate trains of ideas. They thus come to be more than gestures; they become 'conventions.'

"One finds examples of the use of conventions in all sorts of cases of intimate relations. After associating with an infant for a

little while, one knows what the infant wants when he makes a particular kind of noise. The reason for this ability to interpret the expressions of the infant is that the merest indication calls up in the mind of the observer earlier cases which were interpreted after full contact with the infant's needs and the means of satisfying these needs."

Vocal Reactions. "It is an interesting fact in human history that during the course of evolution by which gestures were simplified and elevated to the level of conventional modes of expression a selection went forward which gave preference to the vocal cords as the particular organs for social communication. The hands were used very freely in early savage communication, but it soon became evident that communication would be very limited if the hands had to be used as the chief means of expressing ideas. Furthermore, the hands were engaged for the most part in other occupations. A striking illustration of this appears in the fact that, when a savage was called upon to hold a parley with an enemy, he was much engaged, so far as his hands were concerned, in preparing to defend himself. He had to hold his shield, and his spear in readiness for action. A parley with an enemy, therefore, was seriously inhibited if the only avenue of expression was the hands. In the same way the members of a friendly group who were working together in the field found that they needed their hands to execute the work which brought them together and that, if they wanted to express to one another the rhythm of their occupation or any other ideas, it was inconvenient to stop the work and use their hands for communication.

"The vocal cords are especially adapted to social communication. They are, in the first place, capable of producing a type of stimulation for the auditor's nervous system which is quite as vivid as that which is produced by the hand when it appeals to the observer's eye. In the second place, they are not dependent on external conditions, as are all movements which require light in order to be seen. The vocal cords produce their own energy and can be used at the speaker's will in the dark as well as in the light. In the third place, as pointed out in a preceding paragraph, the vocal cords are free from all practical demands. They are of no use for any of the practical activities of life. They are so detached from the hand and other active organs that they can be

used for purposes of expression during a period of work or while the speaker is preparing to defend himself by the use of weapons.

"The great advantage of oral expression as a medium of communication led very early in the history of the race to the use of sounds as a means of holding the group together. We know, for example, that some of the earliest forms of language were the so-called 'songs' or rhythmical intonations used by a group of workers in the field. These were of the same type as the songs used in modern life by a group of sailors who sing as they work together in pulling in a rope. . . .

"These early forms of social expressions had to be elaborated, and they were elaborated in the course of history in several different directions. In the first place, the number of sounds produced had to be greatly enlarged. Primitive words are few in number and monosyllabic in form. In modern speech we have a huge vocabulary, and the form of many words is very complex. We are constantly expressing single ideas with three or more syllables, showing that we have found it necessary to compound the sounds which are used in calling attention to even a simple object.

"As soon as the need for many different expressions began to appear, language became cumbersome and devices had to be invented for holding together those expressions which are somewhat of the same significance. Methods of expressing related ideas, methods of expressing the past tense of verbs, and other similar devices were produced, as has been indicated in earlier paragraphs of this chapter, by the gradual development of certain uniform modes of expression for all ideas which are similar in type.

"With the growth of the vocabulary came the evolution of the sentence. Series of words are necessary to describe most situations, and rules governing series of words were developed through usage so as to insure common modes of expression and common interpretations.

"*Individual Acquisition of Language.* The various steps thus noted as parts of the evolutionary process which produced language reappear as phases of individual acquisition of language. To be sure, racial evolution and individual acquisition are not identical. When a child comes into an American community, it is not necessary for him to develop the English language again.

All that is required of him is that he learn its established forms. He must acquire as rapidly as possible the vocabulary and the syntax which are sanctioned by use.

"*The School and Language.* So elaborate has modern language become that a mastery of the modes of expression which are necessary for the complete communication of ideas cannot be acquired merely through the imitation of one's parents. The school very early found that it was necessary, in order to give range to expression, to devote time to the first of the types of enlargement mentioned in a preceding paragraph, namely, the enlargement of the vocabulary, particularly when language had to cover some new field of knowledge.

"Thus, when the medieval universities of Europe began to teach law, it was found necessary to develop a series of legal terms which students did not acquire at home, and the acquisition of these legal terms was an important part of the instruction given to students in the university.

"In the same way, theology, and, later, mathematics and the other sciences, called for special modes of expression which constituted an enlargement of the student's language and required a systematic arrangement of terms which was so elaborate that only a protracted period of training could give the learner a fair mastery of the system of thought involved.

"It was true, furthermore, in the early period of European education that the special vocabularies belonged to a language other than the vernacular of the students. Thus, the practice became established in Occidental educational institutions of requiring a foreign language of all who would share in the higher learning.

"School instruction early coupled syntax and composition by the pupil with the learning of an enlarged vocabulary. The result was that a very large share of the time and energy of teachers was from the first given to teaching language.

"It should not be thought that language was or is the final goal of teaching. It is an indispensable mode of expression and communication. When language reaches a stage of evolution such as we find in modern civilization, it has become something far too elaborate to be described as natural or as the outcome of mere instinctive emotional reactions. Language has become the vehicle for all the higher forms of mental life. More than this, it is the

means by which the mind records its achievements. The relation between language and thought becomes so intimate that the two are psychologically inseparable."

[Judd, C. H., *Psychology of Secondary Education* (Ginn and Company, Boston, 1927), pp. 189–199. By permission.]

The emphasis that the schools place on language may as easily become a source of grave danger in education as a source of great strength. Probably no one has expressed these alternative possibilities better than has Professor Dewey in the quotation which follows.

2. THE ABUSE OF LINGUISTIC METHODS IN EDUCATION

Learning Concerned with Meanings. "Taken literally, the maxim, 'Teach things, not words,' or 'Teach things before words,' would be the negation of education; it would reduce mental life to mere physical and sensible adjustments. Learning, in the proper sense, is not learning things, but the meanings of things, and this process involves the use of signs, or language in its generic sense. In like fashion, the warfare of some educational reformers against symbols, if pushed to extremes, involves the destruction of the intellectual life, since this lives, moves, and has its being in those processes of definition, abstraction, generalization, and classification that are made possible by symbols alone. Nevertheless, these contentions of educational reformers have been needed. The liability of a thing to abuse is in proportion to the value of its right use."

Words May Be Meaningless to User. "Symbols are themselves . . . particular, physical, sensible existences, like any other things. They are symbols only by virtue of what they suggest and represent, i. e. meanings. (i) They stand for these meanings to any individual only when he has had experience of some situation to which these meanings are actually relevant. Words can detach and preserve a meaning only when the meaning has been first involved in our own direct intercourse with things. To attempt to give a meaning through a word alone without any dealings with a thing is to deprive the word of intelligible signification; against this attempt, a tendency only too prevalent in education, reformers have protested. Moreover, there is a tend-

ency to assume that whenever there is a definite word or form of speech there is also a definite idea; while, as a matter of fact, adults and children alike are capable of using even precise verbal formulæ with only the vaguest and most confused sense of what they mean. Genuine ignorance is more profitable because likely to be accompanied by humility, curiosity, and open-mindedness; while ability to repeat catch phrases, cant terms, familiar propositions, gives the conceit of learning and coats the mind with a varnish waterproof to new ideas."

Limits to Contextual Meanings. "(ii) Again, although new combinations of words without the intervention of physical things may supply new ideas, there are limits to this possibility. Lazy inertness causes individuals to accept ideas that have currency about them without personal inquiry and testing. A man uses thought, perhaps, to find out what others believe, and then stops. The ideas of others as embodied in language become substitutes for one's own ideas. The use of linguistic studies and methods to halt the human mind on the level of the attainments of the past, to prevent new inquiry and discovery, to put the authority of tradition in place of the authority of natural laws and facts, to reduce the individual to a parasite living on the second-hand experience of others—these things have been the source of the reformers' protest against the preëminence assigned to language in schools."

Words May Become Mere Physical Counters. "Finally, words that originally stood for ideas come, with repeated use, to be mere counters; they become physical things to be manipulated according to certain rules, or reacted to by certain operations without consciousness of their meaning. Mr. Stout (who has called such terms 'substitute signs') remarks that 'algebraical * and arithmetical signs are to a great extent used as mere substitute signs. . . . It is possible to use signs of this kind whenever fixed and definite rules of operation can be derived from the nature of the things symbolized, so as to be applied in manipulating the signs, without further reference to their signification. A word is an instrument for thinking about the meaning which it expresses; a substitute sign is a means of not thinking about the meaning it symbolizes.' The principle applies, however, to ordinary words, as

* Stout, G. F., *Analytical Psychology*, Vol. II. By permission of The Macmillan Company.

well as to algebraic signs; they also enable us to use meanings so as to get results without thinking. In many respects, signs that are means of not thinking are of great advantage; standing for familiar, they release attention for meanings that, being novel, require conscious interpretation. Nevertheless, the premium put in the schoolroom upon attainment of technical facility, upon skill in producing external results, often changes this advantage into a positive detriment. In manipulating symbols so as to recite well, to get and give correct answers, to follow prescribed formulæ of analysis, the pupil's attitude becomes mechanical, rather than thoughtful; verbal memorizing is substituted for inquiry into the meaning of things. This danger is perhaps the one uppermost in mind when verbal methods of education are attacked."

Use of Language in Education. "Language stands in a twofold relation to the work of education. On the one hand, it is continually used in all studies as well as in all the social discipline of the school; on the other, it is a distinct object of study. We shall consider only the ordinary use of language, since its effects upon habits of thought are much deeper than those of conscious study.

"The common statement that 'language is the expression of thought' conveys only a half-truth, and a half-truth that is likely to result in positive error. Language does express thought, but not primarily, nor, at first, even consciously. The primary motive for language is to influence (through the expression of desire, emotion, and thought) the activity of others; its secondary use is to enter into more intimate sociable relations with them; its employment as a conscious vehicle of thought and knowledge is a tertiary, and relatively late, formation. The contrast is well brought out by the statement of John Locke that words have a double use,—'civil' and 'philosophical.' 'By their civil use, I mean such a communication of thoughts and ideas by words as may serve for the upholding of common conversation and commerce about the ordinary affairs and conveniences of civil life. . . . By the philosophical use of words, I mean such a use of them as may serve to convey the precise notions of things, and to express in general propositions certain and undoubted truths.'

"This distinction of the practical and social from the intellectual use of language throws much light on the problem of the school in respect to speech. That problem is to direct pupils' oral

and written speech, used primarily for practical and social ends, so that gradually it shall become a conscious tool of conveying knowledge and assisting thought. How without checking the spontaneous, natural motives—motives to which language owes its vitality, force, vividness, and variety—are we to modify speech habits so as to render them accurate and flexible intellectual instruments? It is comparatively easy to encourage the original spontaneous flow and not make language over into a servant of reflective thought; it is comparatively easy to check and almost destroy (so far as the schoolroom is concerned) native aim and interest, and to set up artificial and formal modes of expression in some isolated and technical matters. The difficulty lies in making over habits that have to do with 'ordinary affairs and conveniences' into habits concerned with 'precise notions.' The successful accomplishing of the transformation requires (i) enlargement of the pupil's vocabulary; (ii) rendering its terms more precise and accurate, and (iii) formation of habits of consecutive discourse."

[Dewey, J., *How We Think* (D. C. Heath & Co., Boston, 1911), pp. 176–180. By permission.]

3. IMAGINATION

Nature of Imagination. "The term imagination in its widest sense is the image-making faculty. In this sense memory images are particular classes of the process of imagination, viz., those where the images reproduce with fidelity a former experience. In so far as images appear in consciousness that are not faithful reproductions of past experiences, they may be described as belonging to imagination in the narrower sense of the word. Imagination in the narrow sense comes close to the popular use of the word as that which is purely fanciful. The fanciful or unreal character of some mental images arises through the ability to combine in consciousness elements that have been experienced only separately in perception. Thus the words 'the cow jumped over the moon' in the nursery rhyme bring up imagery that is purely fanciful, because they combine experiences that can be combined only in the form of mental imagery. Even such imagery, which is contradictory to all sensory experience, is, however, fre-

quently of value because of the enjoyment to be obtained from these novel combinations.

"*Function of Imagination.* The ability to reconstruct and recombine in thought is, however, of much greater importance than that of mere enjoyment. Imagination finds its chief function in those cases where it is possible actually to modify our environment so as to make it accord with our mental images, as in inventions. Other cases of a similar sort are those where one looks ahead to certain possible situations, by forming images of that which is likely to happen and makes preparation for the future in this way. Take, for example, the complicated preparations necessary for a polar expedition, which are possible solely because of the ability to imagine what is likely to happen. In such forms of the imagination man goes much beyond the stage of mere fanciful imagination useful only for purposes of enjoyment. He has the capacity thereby 'to look before and after'—'to prepare for war in time of peace.' As far as we can tell, the lower animals are able to do this to a very limited extent, most of their provisions for the future being purely instinctive.

"Furthermore, many of the most important scientific facts can never be directly experienced through the senses. They must, in other words, be imagined. Ether, electricity, gravity, atoms, etc., are all facts that could be experienced in no other way. Imagination helps to fill in the gaps of our sense experience, and thus gives a truer picture of reality than the senses can without its aid. The truth of the picture in such cases is dependent largely on whether these products of the imagination actually correspond with, and do not contradict, those sense experiences on which they are built.

"*Development of Imagination.* This last statement gives the proper clue to the cultivation of the imagination. It is known to everybody who has studied children that they revel in imaginary experiences. Two extreme views have been held with regard to the wisdom of cultivating this tendency, both of these views being the result of psychological misconception. According to one view, since imagination is false and impractical in its results, the child's tendencies in this direction should be restrained. Fairy stories and myths should be replaced by 'what is true.' The other view holds that, since imagination is natural to the child and

since it is a useful function, it should be cultivated as much as possible, and one should be careful not to break into the fancies of childhood by the introduction of prosaic reality.

"The truth that follows from a correct analysis of the situation has been foreshadowed in our earlier treatment of this subject. Imagination is a useful function in so far as it leads to useful activities. Not every fancy, therefore, contributes to a useful end, but only those that may be made to conform to reality either by leading to actual constructions or by furnishing products of imagination that are useful because of their literary, artistic or scientific character. It is when the child is not taught to distinguish sharply between the truth and falsity of his imaginations that harm arises from a cultivation of the imagination. Furthermore, it should always be remembered that imagination is dependent for its content on sensory experiences. The cultivation of imagination, therefore, requires rich and varied experience of the world of external objects and events. Such means of developing those forms of imagination that we call scientific and practical are clearly necessary. But the following testimony from a great writer of fiction, Sir Walter Scott, shows its necessity in cases that we ordinarily regard as far removed from sensory experiences. While visiting a certain Mr. Morritt, Scott said to his host:

" 'You have given me materials for romance: now I want a good robber's cave, and an old church of the right sort.' 'We rode out,' says Mr. Morritt, 'and he found what he wanted in the ancient slate quarries of Brignal and the ruined abbey of Eggleston. I observed him noting down even the peculiar little wild flowers and herbs that accidentally grew around and on the side of a bold crag near his intended cave of Guy Denzil; and could not help saying that, as he was not to be on oath in his work, daisies, violets and primroses would be as poetical as any of the humbler plants he was examining. I laughed, in short, at his scrupulousness; but I understood him when he replied that in Nature herself no two scenes were exactly alike, and that whoever copied truly what was before his eyes would possess the same variety in his descriptions, and exhibit apparently an imagination as boundless as the range of nature in the scenes he recorded; whereas whoever trusted to (purely fanciful) imagination would soon find his own mind circumscribed and contracted

to a few favorite images, and the repetition of these would sooner or later produce that very monotony and barrenness which had always haunted descriptive poetry in the hands of any but the patient worshipers of truth.' *

[Cameron, E. H., *Psychology and the School* (The Century Co., New York, 1921), pp. 122–126.]

Among the most important classes of ideas with which the teacher must be concerned are those called ideals, and probably at no point is there more danger that ideas will be divorced from conduct. The psychological nature of ideals and their relationship to behavior is carefully described in the following paragraphs.

4. THE ACQUISITION OF IDEALS †

The Nature of Ideals. "Among other abstract ideas, honesty, truthworthiness, justice, fair play, loyalty, mercy, and the like have been included. The term ideal is used in several senses, but most commonly to embrace the idea of the characteristics of honest, loyal, or merciful behavior plus an impulse to act in the characteristic way when the appropriate situation is provided. The impulse to action is subordinate to the perception or idea, in the sense that an individual cannot generally act honestly unless he is aware of what constitutes the honest course of action. The development of honesty in behavior, then, is in part dependent upon the development of the ability to perceive what we may call the honesty element in various situations. A clear idea of honesty is acquired in the same way that ideas of squareness, angles, four-ness are carried at by analysis and eventual abstraction. The learner is assisted as before by meeting the 'honest' feature of many different situations, by an analytical attitude, by having the element pointed out and emphasized, by contrasting it with dishonesty, by verbal explanations and formulations. As in the acquisition of other facts, honesty will not be thoroughly understood or dynamically effective by verbal instruction or deductive exercise alone, nor will the idea be most clearly acquired

* Bolton, F. E., *Principles of Education*, quoting from Sir Walter Scott. By permission of Chas. Scribner's Sons.

† Gates, A. I., *Psychology for Students of Education* (The Macmillan Company, New York, 1923), pp. 319–322. By permission.

by experience alone—the two are acquired together, each supplementing the other. Ideals become effective impulses to action, when the idea is clearly perceived and followed by action with a satisfying effect. In moral training, each of these features must be developed—the perception of the moral quality and the doing of the moral act, followed by a satisfying state of affairs. When experience has been sufficient to enable one to perceive the moral aspect, as we perceive blueness or roundness in any situation, and when the percept or idea is followed by the impulse to act accordingly, we have the ideal in dynamic form.

"Children occasionally act in an inappropriate manner because they do not perceive the proper line of action; their idea is incomplete and inapplicable to some situations. For example, many seven-year-old pupils, in answer to the question: 'What's the thing for you to do if a playmate hits you without meaning to do it?' give such answers as 'Get even'; 'Tell him to "cut it out"'; 'Tell my mama'; 'Not play with him' or otherwise show a failure to perceive the essential moral feature of the situation. To extract the proper moral quality is not of itself a guarantee of proper action, but it is a desirable antecedent.

"*An Experimental Study.* An experimental study by Voelker gives an illustration of the simultaneous development of moral ideas and moral courage. Six groups of about a dozen boys each, of ages ten to fourteen, were first given a series of ten tests which offered an opportunity for either trustworthy or untrustworthy behavior. Situations were provided offering the boy an opportunity to keep over-change, to steal, to cheat in an examination, to tell a secret, to make false claims, etc. Each test provided a real temptation; dishonesty would be rewarded by some immediate personal gain. The boys, of course, were unaware that the temptations were pre-arranged. In the first trials, the temptations were effective in various degrees, ranging from untrustworthiness in eight out of ten tests to one out of ten; only one boy was one hundred percent honest. The average boy proved suspectible to three or four of the ten tests.

"During a period of seven weeks, two groups were given intensive training, which embraced the learning of codes of trustworthiness, Boy Scout oaths, lectures, and an abundance of cautions, exhortations, encouragement, and explanations during games, examinations, hikes, group meetings, and other Boy Scout

activities. Rewards and punishments were administered as occasions made them advisable. In short, the leaders of the two groups attempted by many devices to develop and clarify the notion of truthworthiness, to develop ability to see it in many different situations, and to form habits of acting in a trustworthy way.

"Two other groups were given the ordinary Boy Scout training in which, presumably, less effective interpenetration of verbal instruction and experience was obtained and the development of trustworthiness was less deliberately designed. Two other groups of school boys were given no Boy Scout training and no special training in trustworthiness. At the end of the seventh week, the six groups were again put through a series of ten tests which were new in material but in general type similar to those of the first series. The two groups systematically trained in trustworthiness improved the most; the two untrained schoolboy groups the least; with the regular Boy Scout group about midway between. The specially trained group did not achieve perfect trustworthiness, however. They were guilty of untrustworthy acts, on the average, in about two out of ten tests. Some of the failures probably were due to inability to perceive the right clearly, while others were instances of seeing the right but doing the wrong. The greatest improvement, however, was obtained by the deliberate selection of life situations, which afford opportunity to perceive and do the trustworthy act, along with verbal explanations and formulations such as slogans and mottoes which became meaningful by penetrating the experience and in turn made the experience more intelligible and fruitful."

How Ideas Become Effective Ideals. "But ideas become effective ideals only when they have led promptly to action that is accompanied or followed by satisfying effects. When this occurs frequently, the idea becomes an impulse to action; the individual is ready to act, and, as elsewhere, for him then to act is satisfying, for him not to act or to act differently is annoying."

[Gates, A. I., *Psychology for Students of Education.* By permission of The Macmillan Company.]

Investigations show that many students employ extremely inefficient methods of study. It is, therefore, of considerable importance for both the teacher and pupil to understand something

of its nature and the factors which make for success. Some of these factors are not of a strictly psychological nature, but the most important aspects of study belong here.

5. METHODS OF STUDY

Directing Study Versus Hearing Lessons. "The story is told of a woman who came to a city school superintendent with a somewhat peculiar request. She was a widow with three children and had to get up very early to prepare herself for work, and her children for school. Returning home at 6 o'clock at night she got ready the evening meal and afterwards washed the dishes and tidied the house. She then thought it necessary to sit down with her children and assist them in studying the lessons, which, as she put it to the superintendent, 'your teachers will hear them recite the following day.' 'If it is just the same to you,' she continued, 'I would like to have the teachers help the children during the day, and let me hear them say their lessons at night. It would be much easier for me.'

"This story raises the question of the teacher's function in an apt and emphatic manner. More and more we are coming to see that the teacher's most important duty is directing study rather than hearing lessons. While it is an important part of a teacher's work to test the pupil's knowledge, it is a relatively unimportant part, and one which it is safe to say, has been over-emphasized in most schools."

Study and Curiosity. "The primary prerequisite in all study is a certain attitude of intellectual curiosity on the part of the student. At best the teacher's part consists merely in being the means of stimulating and directing the pupil's self-activity. But this does not mean that the teacher's part is not important. The teacher is responsible for the creation of an enthusiasm for the work of the school in the case of pupils—of pupils who would not otherwise have it. By proper direction of the student's emotional life the desire for knowledge may become a dominating factor in all his work, and without such an attitude, study activities will have to overcome an inertia that will be the source of constant strain. The first rule of study is, therefore, to create in the pupil motives for study and a desire to study."

Study as Reading. "In the second place study may be regarded

from the standpoint of reading. A very large part of all the study of the school is directly dependent on this ability. But recent investigations have shown that even high school students are frequently unable to read in any efficient fashion. The teacher must, therefore, assure himself that the student's difficulties in regard to study are not first of all due to the fact that he has never learned to read silently with any degree of efficiency which would enable him to cover his high school lessons in a reasonable amount of time. In the case of such students the first requirement, therefore, is practice in increasing the rate of silent reading or learning to comprehend more clearly what is read or both."

Study as Attention. "In the next place, study is a process of attention. This very obvious relation of attention to study raises the problem of training the attention. Are there rules for the training of attention? If so, what are they? We sometimes think of attention as if it were some kind of a force within us that can be turned off or on at 'will.' But as a matter of fact it will be found that the capacity to attend so far as it relates to study is always the result of training. It is useless to ask the pupil to attend if he has not learned the trick, and if he has not he must be encouraged to persist until he gradually acquires the necessary capacity. It cannot be expected to appear full blown in the life of any individual. Beyond the persistent training of this capacity there are some rules which may be given to secure the most favorable conditions for attention. In many cases, for example, the difficulty is in getting started upon the study activity. If one will force himself to act in any way closely related to the work at hand the task becomes easier from that moment. To start in and do something—begin to read, to take notes, etc., is to have half won the battle, for the inertia having once been overcome the subsequent action is easier. One's energy having once been directed in the right direction, it continues of its own accord to carry us along in its tide. Another important rule for the most economical learning is to place oneself in the physical environment which is most favorable to concentration of attention. The difficulty of obtaining such conditions in the typical home is one of the chief arguments in favor of some form of so-called supervised study."

Memorizing. "Again, study is memorizing. This phase of study may easily be neglected, but if our educational methods are ever

going to escape from the stigma so often attached to them, namely, lack of thoroughness, the pupil must learn to make the object of his study a permanent possession of his mind. It is perfectly proper and necessary to decry the evils of cramming and purely rote memory, but in our reaction against this form of memorizing we are in danger of neglecting an essential phase of the learning process.

"Students come to me and say by way of excuse for poor work, 'I have such a poor memory.' They imply that they regard themselves, nevertheless, as well equipped for the intellectual life, for they have the ability to think. But thinking cannot go on in a vacuum. One cannot think without a store of facts, ideas, and principles, and the student whose thinking is not supported by a solid basis of facts builds without foundation and when the winds blow and beat upon his house it will fall.

"I sometimes think that students are of two types in respect to this aspect of study. Some students grasp general conclusions, principles and laws, relatively easily, but they are impatient of facts. Details bore them and so they refuse to go through the necessary labor of memorizing. On the other hand, there is the type of student who finds the mere memorizing of facts relatively easy but finds it difficult to arrive at general conclusions. Happy is the student who combines these capacities in proper proportions.

Rules for Memorizing. "The experimental psychology of memory has given many useful insights into this phase of study, only a few of which I can allude to here, and these at no great length.

"Have confidence in your memory. Memory is like a friend who can be counted on to give his assistance the more he is trusted. Having thoroughly learned a thing, the proper procedure is to dismiss it from consciousness and expect that it will reappear when the proper occasion arises. The more one relies on notes and references, the more is it necessary to do so. This is no place to enter into a discussion of the vexed question of whether the memory in general can be trained, but all psychologists agree that the more the memory is relied on and used, the more useful a function it becomes. . . .

"Closely allied to what has just been said is the rule that in memorizing one should have the 'will to remember.' Experiment shows that material learned with the definite intention of using

it, in some more or less definite way, on some more or less definite occasion is much better retained than when it is learned without any reference to its possible future use. It is of great advantage, therefore, to the student, if he has in mind during his study what he intends to do with the material studied. To study in order to recite to the teacher the next day, or to pass an examination the next week, or even to use it on some future occasion, only vaguely foreseen, will bring better results than to merely study because one must but without any future reference. . . .

"Most school study is, unfortunately perhaps, in terms of language. . . . To use one's ideas helps to fix them in the mind. He who always has a fund of stories to tell is the one who is continually telling them. Even when the use to which the ideas are put is the usual type of school work—the recitation, the examination, etc., this principle is of importance. The teacher should encourage the pupil to use his knowledge and should create situations which make it necessary to apply it in as practical a way as the conditions of the school make possible. . . .

"Many pupils learn for themselves that it is advantageous for them to attempt to recall what is being studied before it has been completely mastered. Careful experiments have shown that this is a valid principle for memorizing. Not only does this method reveal those portions which need the most further attention, but the mere effort at recall is an aid in the further complete memorization of the subject. . . .

"It is well understood by all that the better materials for study are understood, the more easily are these materials memorized. Because of this it is usually a good plan to read an assignment over as a whole rather hastily before beginning detailed study on the assignment. In this way the general bearing of the details is more easily grouped and in the same degree made more intelligible to the student.

"It is known from the results of experiment that when a student has a certain length of time to devote to the study of a certain lesson, it is better to distribute this time over two or more periods rather than to bunch the learning into a single period. Doubtless the optional periods of distribution differ with different individuals and with different subjects. We do not know, for example, whether a course in algebra given every school day for a year is as efficient as one given every other day for a

period of two years. Personally, I believe that the latter is the better procedure, but while I have some evidence that this is true from my own experience of high school teaching, I should not wish to state this conviction too strongly until it is put to the test of experiment."

Study as Reflective Thought. "Last but most important of all is the rule that study should consist in reflective thought. Most of the materials of study consist of series of more or less related problems—and their solutions. It is only when the student raises these problems for himself, and actively incorporates the solution into the body of his own reflective thought, that his study habits can be said to have reached a truly efficient level. It is the student who is continually reacting to his books by raising questions, and thinking out the answers to these questions, who obtains knowledge that is useful, and at the same time makes his study easy."

[Cameron, E. H., in *Proceedings of High School Conference*, University of Illinois, XIX, 21, pp. 71–73.]

QUESTIONS

1. Can you discover in yourself tendencies to muscular contraction in thinking of words? If so, are they definite enough to describe or localize in any way?
2. What is the relation between language and emotional reactions?
3. How does animal communication differ from language, if at all?
4. Distinguish between natural and conventional signs.
5. What are the advantages of vocal reactions over hand reactions for purposes of communication?
6. What are the three dangers to genuine learning involved in the use of language?
7. What is the problem of the school with respect to the practical and intellectual uses of language?
8. Discuss the nature of imagination, its function, and the means of its training.
9. In what sense does an ideal differ from an idea?
10. What is the relation between moral ideals and behavior?
11. How may ideals be best developed?
12. Make as many rules for study as you can, basing the rules on known psychological principles.

CHAPTER XII

REFLECTIVE THINKING

The first reading in this chapter is from Dewey's well-known chapter "The Analysis of a Complete Act of Thought." This chapter furnishes the central theme of the author's *How We Think,* a book of such importance from the standpoint of educational psychology that every student of the subject should be familiar with it.

1. THE ANALYSIS OF A COMPLETE ACT OF THOUGHT

". . . We shall make an analysis of the process of thinking into its steps or elementary constituents, basing the analysis upon descriptions of a number of extremely simple, but genuine, cases of reflective experience." *

Illustrations of Reflective Thinking. "1. 'The other day when I was down town on 16th Street a clock caught my eye. I saw that the hands pointed to 12.20. This suggested that I had an engagement at 124th Street, at one o'clock. I reasoned that as it had taken me an hour to come down on a surface car, I should probably be twenty minutes late if I returned the same way. I might save twenty minutes by a subway express. But was there a station near. If not, I might lose more than twenty minutes in looking for one. Then I thought of the elevated, and I saw there was such a line within two blocks. But where was the station? If it were several blocks above or below the street I was on, I should lose time instead of gaining it. My mind went back to the subway express as quicker than the elevated; furthermore, I remembered that it went nearer than the elevated to the part of 124th Street I wished to reach, so that time would be saved at the end of the journey. I concluded in favor of the subway, and reached my destination by one o'clock.'

* "These are taken, almost verbatim, from the class papers of students.

"2. 'Projecting nearly horizontally from the upper deck of the ferryboat on which I daily cross the river, is a long white pole, bearing a gilded ball at its tip. It suggested a flagpole when I first saw it; its color, shape, and gilded ball agreed with this idea, and these reasons seemed to justify me in this belief. But soon difficulties presented themselves. The pole was nearly horizontal, an unusual position for a flagpole; in the next place, there was no pulley, ring, or cord by which to attach a flag; finally, there were elsewhere two vertical staffs from which flags were occasionally flown. It seemed probable that the pole was not there for flag-flying.

" 'I then tried to imagine all possible purposes of such a pole, and to consider for which of these it was best suited: (a) Possibly it was an ornament. But as all the ferryboats and even the tugboats carried like poles, this hypothesis was rejected. (b) Possibly it was the terminal of a wireless telegraph. But the same considerations made this improbable. Besides, the more natural place for such a terminal would be the highest part of the boat, on top of the pilot house. (c) Its purpose might be to point out the direction in which the boat is moving.

" 'In support of this conclusion, I discovered that the pole was lower than the pilot house, so that the steersman could easily see it. Moreover, the tip was enough higher than the base, so that, from the pilot's position, it must appear to project far out in front of the boat. Moreover, the pilot being near the front of the boat, he would need some such guide as to its direction. Tugboats would also need poles for such a purpose. This hypothesis was so much more probable than the others that I accepted it. I formed the conclusion that the pole was set up for the purpose of showing the pilot the direction in which the boat pointed, to enable him to steer correctly.'

"3. 'In washing tumblers in hot soapsuds and placing them mouth downward on a plate, bubbles appeared on the outside of the mouth of the tumblers and then went inside. Why? The presence of bubbles suggests air, which I note must come from inside the tumbler. I see that the soapy water on the plate prevents escape of the air save as it may be caught in bubbles. But why should air leave the tumbler? There was no substance entering to force it out. It must have expanded. It expands by increase of heat or by decrease of pressure, or by both. Could

the air have become heated after the tumbler was taken from the hot suds? Clearly not the air that was already entangled in the water. If heated air was the cause, cold air must have entered in transferring the tumblers from the suds to the plate. I test to see if this supposition is true by taking several more tumblers out. Some I shake so as to make sure of entrapping cold air in them. Some I take out holding mouth downward in order to prevent cold air from entering. Bubbles appear on the outside of every one of the former and on none of the latter. I must be right in my inference. Air from the outside must have been expanded by the heat of the tumbler, which explains the appearance of the bubbles on the outside.

" 'But why do they then go inside? Cold contracts. The tumbler cooled and also the air inside it. Tension was removed, and hence bubbles appeared inside. To be sure of this, I test by placing a cup of ice on the tumbler while the bubbles are still forming outside. They soon reverse.'

"These three cases have been purposely selected so as to form a series from the more rudimentary to more complicated cases of reflection. The first illustrates the kind of thinking done by everyone during the day's business, in which neither the data, nor the ways of dealing with them, take one outside the limits of everyday experience. The last furnishes a case in which neither problem nor mode of solution would have been likely to occur except to one with some prior scientific training. The second case forms a natural transition; its materials lie well within the bounds of everyday, unspecialized experience; but the problem, instead of being directly involved in the person's business, arises indirectly out of his activity, and accordingly appeals to a somewhat theoretic and impartial interest. We shall deal, in a later chapter, with the evolution of abstract thinking out of that which is relatively practical and direct; here we are concerned only with the common elements found in all the types."

The Five Steps in Reflective Thinking. "Upon examination, each instance reveals, more or less clearly, five logically distinct steps: (I) a felt difficulty; (II) its location and definition; (III) suggestion of possible solution; (IV) development by reasoning of the bearings of the suggestion; (V) further observation and experiment leading to its acceptance or rejection; that is, the conclusion of belief or disbelief."

The Felt Difficulty. "1. The first and second steps frequently fuse into one. The difficulty may be felt with sufficient definiteness as to set the mind at once speculating upon its probable solution, or an undefined uneasiness and shock may come first, leading only later to definite attempt to find out what is the matter. Whether the two steps are distinct or blended, there is the factor emphasized in our original account of reflection—viz. the perplexity or problem. In the first of the three cases cited, the difficulty resides in the conflict between conditions at hand and a desired and intended result, between an end and the means for reaching it. The purpose of keeping an engagement at a certain time, and the existing hour taken in connection with the location, are not congruous. The object of thinking is to introduce congruity between the two. The given conditions cannot themselves be altered; time will not go backward nor will the distance between 16th Street and 124th Street shorten itself. The problem is *the discovery of intervening terms which when inserted between the remoter end and the given means will harmonize them with each other.*

"In the second case, the difficulty experienced is the incompatibility of a suggested and (temporarily) accepted belief that the pole is a flagpole, with certain other facts. Suppose we symbolize the qualities that suggest *flagpole* by the letters a, b, c; those that oppose this suggestion by the letters p, q, r. There is, of course, nothing inconsistent in the qualities themselves; but in pulling the mind to different and incongruous conclusions they conflict—hence the problem. Here the object is the discovery of some object (O), of which a, b, c, and p, q, r, may all be appropriate traits—just as, in our first case, it is to discover a course of action which will combine existing conditions and a remoter result in a single whole. The method of solution is also the same: discovery of intermediate qualities (the position of the pilot house, of the pole, the need of an index to the boat's direction) symbolized by d, g, l, o, which bind together otherwise incompatible traits.

"In the third case, an observer trained to the idea of natural laws or uniformities finds something odd or exceptional in the behavior of the bubbles. The problem is to reduce the apparent anomalies to instances of well-established laws. Here the method of solution is also to seek for intermediary terms which will

connect, by regular linkage, the seemingly extraordinary movements of the bubbles with the conditions known to follow from processes supposed to be operative."

Its Location and Definition. "2. As already noted, the first two steps, the feeling of a discrepancy, or difficulty, and the acts of observation that serve to define the character of the difficulty may, in a given instance, telescope together. In cases of striking novelty or unusual perplexity, the difficulty, however, is likely to present itself at first as a shock, as emotional disturbance, as a more or less vague feeling of the unexpected, of something queer, strange, funny, or disconcerting. In such instances, there are necessary observations deliberately calculated to bring to light just what is the trouble, or to make clear the specific character of the problem. In large measure, the existence or non-existence of this step makes the difference between reflection proper, or safeguarded *critical* inference and uncontrolled thinking. Where sufficient pains to locate the difficulty are not taken, suggestions for its resolution must be more or less random. Imagine a doctor called in to prescribe for a patient. The patient tells him some things that are wrong; his experienced eye, at a glance, takes in other signs of a certain disease. But if he permits the suggestion of this special disease to take possession prematurely of his mind, to become an accepted conclusion, his scientific thinking is by that much cut short. A large part of his technique, as a skilled practitioner, is to prevent the acceptance of the first suggestions that arise; even, indeed, to postpone the occurrence of any very definite suggestion till the trouble—the nature of the problem—has been thoroughly explored. In the case of a physician this proceeding is known as diagnosis, but a similar inspection is required in every novel and complicated situation to prevent rushing to a conclusion. The essence of critical thinking is suspended judgment; and the essence of the suspense is inquiry to determine the nature of the problem before proceeding to attempts at its solution. This, more than any other thing, transforms mere inference into tested inference, suggested conclusions into proof."

Suggestions of Solution. "3. The third factor is suggestion. The situation in which the perplexity occurs calls up something not present to the senses: the present location, the thought of

subway or elevated train; the stick before the eyes, the idea of a flagpole, an ornament, an apparatus for wireless telegraphy; the soap bubbles, the law of expansion of bodies through heat and their contraction through cold. (a) Suggestion is the very heart of inference; it involves going from what is present to something absent. Hence, it is more or less speculative, adventurous. Since inference goes beyond what is actually present, it involves a leap, a jump, the propriety of which cannot be absolutely warranted in advance, no matter what precautions be taken. Its control is indirect, on the one hand, involving the formation of habits of mind which are at once enterprising and cautious; and on the other hand, involving the selection and arrangement of the particular facts upon perception of which suggestion issues. (b) The suggested conclusion so far as it is not accepted but only tentatively entertained constitutes an idea. Synonyms for this are *supposition, conjecture, guess, hypothesis,* and (in elaborate cases) *theory.* Since suspended belief, or the postponement of a final conclusion pending further evidence, depends partly upon the presence of rival conjectures as to the best course to pursue or the probable explanation to favor, *cultivation of a variety of alternative suggestions* is an important factor in good thinking."

Reasoning. "4. The process of developing the bearings—or, as they are more technically termed, the *implications*—of any idea with respect to any problem, is termed *reasoning.** As an idea is inferred from given facts, so reasoning sets out from an idea. The *idea* of elevated road is developed into the idea of difficulty of locating station, length of time occupied on the journey, distance of station at the other end from place to be reached. In the second case, the implication of a flagpole is seen to be vertical position; of a wireless apparatus, location on a high part of the ship and, moreover, absence from every casual tugboat; while the idea of index to direction in which the

* "This term is sometimes extended to denote the entire reflective process —just as *inference* (which in the sense of *test* is best reserved for the third step) is sometimes used in the same broad sense. But *reasoning* (or *ratiocination*) seems to be peculiarly adapted to express what the older writers called the 'notional' or 'dialectic' process of developing the meaning of a given idea."

boat moves, when developed, is found to cover all the details of the case.

"Reasoning has the same effect upon a suggested solution as more intimate and extensive observation has upon the original problem. Acceptance of the suggestion in its first form is prevented by looking into it more thoroughly. Conjectures that seem plausible at first sight are often found unfit or even absurd when their full consequences are traced out. Even when reasoning out the bearings of a supposition does not lead to rejection, it develops the idea into a form in which it is more apposite to the problem. Only when, for example, the conjecture that a pole was an index-pole had been thought out into its bearings could its particular applicability to the case in hand be judged. Suggestions at first seemingly remote and wild are frequently so transformed by being elaborated into what follows from them as to become apt and fruitful. The development of an idea through reasoning helps at least to supply the intervening or intermediate terms that link together into a consistent whole apparently discrepant extremes."

Observation and Experiment. "5. The concluding and conclusive step is some kind of *experimental corroboration,* or verification, of the conjectural idea. Reasoning shows that *if* the idea be adopted, certain consequences follow. So far the conclusion is hypothetical or conditional. If we look and find present all the conditions demanded by the theory, and if we find the characteristic traits called for by rival alternatives to be lacking, the tendency to believe, to accept, is almost irresistible. Sometimes direct observation furnishes corroboration, as in the case of the pole on the boat. In other cases, as in that of the bubbles, experiment is required; that is, *conditions are deliberately arranged in accord with the requirements of an idea or hypothesis to see if the results theoretically indicated by the idea actually occur.* If it is found that the experimental results agree with the theoretical, or rationally deduced, results, and if there is reason to believe that *only* the conditions in question would yield such results, the confirmation is so strong as to induce a conclusion—at least until contrary facts shall indicate the advisability of its revision.

"Observation exists at the beginning and again at the end

of the process: at the beginning, to determine more definitely and precisely the nature of the difficulty to be dealt with; at the end, to test the value of some hypothetically entertained conclusion. Between those two termini of observation, we find the more distinctively *mental* aspects of the entire thought-cycle: (I) inference, the suggestion of an explanation or solution; and (II) reasoning, the development of the bearings and implications of the suggestion. Reasoning requires some experimental observation to confirm it, while experiment can be economically and fruitfully conducted only on the basis of an idea that has been tentatively developed by reasoning."

The Logically Trained Mind. "The disciplined, or logically trained, mind—the aim of the educative process—is the mind able to judge how far each of these steps needs to be carried in any particular situation. No cast-iron rules can be laid down. Each case has to be dealt with as it arises, on the basis of its importance and of the context in which it occurs. To take too much pains in one case is as foolish—as illogical—as to take too little in another. At one extreme, almost any conclusion that insures prompt and unified action may be better than any long delayed conclusion; while at the other, decision may have to be postponed for a long period—perhaps for a lifetime. The trained mind is the one that best grasps the degree of observation, forming of ideas, reasoning, and experimental testing required in any special case, and that profits the most, in future thinking, by mistakes made in the past. What is important is that the mind should be sensitive to problems and skilled in methods of attack and solution."

[Dewey, J., *How We Think* (D. C. Heath & Co., Boston, 1911), pp. 68–78. By permission.]

All teachers are in agreement in regard to the importance of training pupils to think. It is not so easy, however, to know exactly what is meant by *thinking*. A psychological analysis of reflective thinking or reasoning will reveal certain factors that are always present, but thinking cannot be properly described as something that occurs, step by step, in a constantly regular manner. Consequently, the student of the subject needs a large number of illustrations such as are given by Swift.

2. THE SOLUTION OF PROBLEMS *

"Since the method by which geniuses solve their problems is the same as that used by the ordinary man in meeting the difficulties of his business or profession, it is worth while to examine the process briefly."

The Incentive to Thinking. "First of all, it should be observed that if everything ran smoothly there would be no thinking. Like everything else, thinking requires a cause, which in this instance is trouble. Doubt, perplexity, uncertainty, an obstacle in the way of what we want to do—all are different names for troubles of one sort or another that interfere with our activities, physical or mental. So long as an automobile is in perfect running order the driver is not concerned with its mechanism. But let it go dead, with seventy-five miles to dinner and the nearest garage, and he is keenly interested in the cause of the trouble."

Suspended Judgment Versus Trial and Error. "The recognition of trouble, however, either in something that we are trying to do or in finding the explanation of a problem is only the incentive to thinking. The cause of the difficulty must be understood before a remedy or a solution can be found, and here we have the second factor in thinking. In certain respects this is the most difficult part of the reasoning process, because most events are exceedingly complex, and the associated incidental factors are so intertwined with the essential elements that it is not easy to separate the essential from the accidental. Science has a way of meeting this perplexity. Experiments are arranged in which one possible cause after another is eliminated, and others, perhaps, exaggerated. In this way, by the process of elimination, the cause of a phenomenon is ascertained."

The Scientific Method. "Certain peculiarities of electricity, for example, must have been observed in ancient times, in lightning, in the aurora borealis, in loadstone, and in certain other substances. In some of these cases the activity was too intense and rapid. In others it was too feeble and obscure. Machines

* From *Psychology and the Day's Work;* copyright, 1918, by Charles Scribner's Sons. By permission of the publishers.

and experiments were needed to produce a continuous supply of electricity of such an intensity as would make it possible to see and test what actually happened. From early times, also, it has been noticed that the tides vary with the phases of the moon. Some connection between these phenomena was assumed, but there was no accurate knowledge of the relation until Newton announced the law of gravitation. Mere observation is likely to be misleading. It would never have shown, for example, that air may exist as liquid and as a solid.

"In many matters, however, as in business and social problems, experimentation is not easy, and frequently it is impossible. Yet these questions are no less complex and involved than the scientific problems to which we have referred. In the former as well as in the latter the difficulty or obstruction in the way of successful progress in thought and action must be located and defined. The ledger does not show the profits which the business conditions lead one to expect. What is the explanation? Is the cause to be found in the internal organization, or lack of organization, or should it be sought among the salesmen? The cause and remedy of political corruption, to cite another instance, has long been a matter of controversy. The ramifications of this disease of the body politic are so extensive that many other social disturbances spring from it. As this is being written there are indications that we are soon to try a tremendously big experiment—the elimination of the saloons. Whatever one's ideas may be regarding 'personal liberty' and 'legislating men good,' it must be admitted that this is the scientific method of locating the cause of the trouble."

The Rôle of Imagination. "This experiment of dispensing with saloons illustrates what is usually called the third step in reasoning—suggestions for remedying the difficulty. As a matter of fact, this is not the usual order of the factors in the process of thinking. Suggestions commonly arise before the difficulty is defined. The wise man, however, suspends judgment, delays acting on suggestions, until the cause has been located. Unfortunately, however, wise men are rare, and consequently suggestions are acted upon hastily and impulsively before the difficulty has been carefully diagnosed and the cause located. It is the trial-and-error method on the animal level—the hit-or-miss method. Yet it is not the way of men who have realized

on their ability. Napoleon, for example, once said; 'If I appear to be always ready to reply to everything, it is because, before undertaking anything, I have meditated for a long time—I have foreseen what might happen. It is not a spirit which suddenly reveals to me what I have to say or do in a circumstance unexpected by others—it is reflection, meditation.' Evidently Napoleon measures up well to the type of which H. G. Wells was thinking when he made Mr. Britling say: 'Will * there ever be a man whose thoughts are quick and his acts slow?' "

The Discovery of Principles. "One of the most charming illustrations of suspended judgment and sensitiveness to suggestion—ability to discover meaning in commonplace events—is the means by which James Bradley explained the apparent movements of the stars about which he had long been puzzled. 'One day when Bradley was out sailing he happened to remark that every time the boat was laid on a different tack the vane at the top of the boat's mast shifted a little, as if there had been a slight change in the direction of the wind. After he had noticed this three or four times he made a remark to the sailors to the effect that it was very strange the wind should always happen to change just at the moment when the boat was going about. The sailors, however, said there had been no change in the wind, but that the alteration in the vane was due to the fact that the boat's course had been altered. In fact, the position of the vane was determined both by the course of the boat and the direction of the wind, and if either of these were altered there would be a corresponding change in the direction of the vane. This meant, of course, that the observer in the boat which was moving along would feel the wind coming from a point different from that in which the wind appeared to be blowing when the boat was at rest, or when it was sailing in some different direction. Bradley's sagacity saw in this observation the clew to the difficulty which had so long troubled him. . . . He argued that as light can only travel with a certain speed, it may in a measure be regarded like the wind, which he noticed in the boat. If the observer were at rest, that is to say, if the earth were a stationary object, the direction in which the light actually does come would be different from that in which it appears

* Wells, H. G., *Mr. Britling Sees It Through.* By permission of The Macmillan Company.

to come when the earth is in motion. . . . Provided with this suggestion, he explained the apparent movement of the stars by the principle known as the "aberration of light." ' This incident in the life of Bradley is comparable in every way to the mythical story of Newton and the apple, which scientists have been so eager to deny lest it remove some of the gloss from scientific thinking. As a matter of fact, reasoning about scientific problems is the same as that which is concerned with the day's work. Discovering the essential element in a bit of experience, and seeing its meaning in relation to the more important questions that trouble one, is thinking.

"Failure to suspend judgment until the essential factors are discovered, and to persevere in the investigation until they are found, is the explanation of many blunders in business and in social reform. Ninety percent of the business ventures are said to be failures, and this is the chief cause. Suspended judgment is not a popular state of mind. Men like to decide and act. An unsettled state of mind is not pleasant.

"The habit of suspending judgment, therefore, is not easily acquired, and there is always a strong tendency to interpret facts so as to make them fit and justify our beliefs. Before Kepler's day, for example, planets were assumed to move in circles. If one were found that did not conform to this 'law,' it was made to agree by saying that the circle in which the planet moved described another circle. Tycho, again, vigorously opposed the Copernican theory, and, by the irony of human psychology, Kepler used Tycho's own observations to add to the proof of the new idea which the master observer had so stoutly denied. And the facts which Owen had patiently collected, to cite another instance, and so serenely interpreted in support of his erroneous belief, were utilized by Darwin in his epoch-making generalization regarding the origin of species. 'We all believe many things which we have no good ground for believing,' Bertrand Russell has said, 'because, subconsciously, our nature craves certain kinds of action which these beliefs would render reasonable if they were true.'

"When Fulton presented his plans of a submarine boat to the British Government—to continue our illustrations of the tendency to hold to fixed opinions—the ministry appointed a commission of five men to examine the matter. So unwilling,

however, were the members of the commission to suspend judgment and investigate—so sure were they of the worthlessness of Fulton's invention—that, after many weeks of delay, they gave an adverse report without even asking Fulton to explain his plans and without having any account before them of the tests and experiments which he had made. The submarine boat referred to in the report was large enough to carry eight men with provisions for twenty days. While under water a reservoir supplied the eight men with air for eight hours; and Fulton himself with three companions had remained under water one hour.

"We are accustomed to say that such things happened a long time ago, and to think that they could not occur now, but a very recent example comparable in all essential respects to the Fulton incident is the treatment which Langley received while working on the aëroplane. The first achievements of the 'flying machine' brought fulsome praise—as success usually does—and a government grant of fifty thousand dollars was easily obtained for the continuance of the experiments. Then difficulties appeared, chiefly with the engine, since the automobile industry had not yet forced its perfection. The preliminary grant was soon exhausted and more money could not easily be obtained to carry on the ludicrous experiments of a science crank. The unscientific editors of science notes in newspapers began to jeer, and 'Langley's Folly' was the joke of small-calibered congressmen. Langley's vindication came, however, in the spring of 1914, when Glenn Curtis wiped the dust from the exhibit of insanity and made the 'Folly' fly. We now know that Langley discovered the essential principle of aëroplanes, and with a little more financial aid he would have made the United States Government, instead of private individuals, the ruler of the air. And his death was hastened by a broken heart because of the ridicule heaped upon him. Now that he is gone, his name is enrolled among the memories of the throng who gave their lives to science and died unappreciated.

"It would seem from the treatment of the men whom we have named, and who are typical of a long list of those who offered something new, as though the incident reported of an Italian town during the Middle Ages were representative of

human experience: 'The citizens of a certain town—Siena seems to be meant—had once an officer in their service who had freed them from foreign aggression; daily they took counsel how to recompense him, and concluded that no reward in their power was great enough not even if they made him lord of their city. At last one of them arose and said: "Let us kill him, and then worship him as our patron saint." And so they did.' * Evidently, a recent writer in the *Atlantic Monthly* was right when he said that 'Dead radicals are honored, not because they were radicals, but because they are dead.' †

"'The undisciplined mind,' says Dewey, speaking of suspended judgment, 'is averse to suspense and intellectual hesitation; it is prone to assertion. It likes things undisturbed, settled, and treats them as such without due warrant. Familiarity, common repute, and congeniality to desire are readily made measuring rods of truth. Ignorance gives way to opinionated and current error—a greater foe to learning than ignorance itself. . . . Our predilection for premature acceptance and assertion, our aversion to suspended judgment, are signs that we tend naturally to short-cut the process of testing. We are satisfied with superficial and immediate short-visioned applications. If these work with moderate satisfactoriness, we are content to suppose that our assumptions have been confirmed.' ‡ Yet delay, pending inquiry and investigation, is the scientific method, and it is the only dependable plan of action. It is the essence of critical thinking. Following this plan, the managers of one of the most successful chains of restaurants in large cities are said never to decide upon a new location without having the people who pass proposed locations counted at noon and evening for a number of days. In this way one source of error is eliminated, and the business problem then resolves itself into furnishing as good a meal for the money as is offered by other restaurants in the vicinity.

"Usually problems are not so simple as this business question,

* Burckhardt, Jacob, *Civilization of the Renaissance in Italy*, p. 23. By permission of The Macmillan Company.

† Deming, Seymour, *Atlantic Monthly*, Vol. 113, p. 587. By permission.

‡ Dewey, John, *Democracy and Education*. By permission of The Macmillan Company.

and the suggestions looking toward their solution must come through the use of a trained and controlled imagination; and in this connection some reflections of Faraday are interesting. He could not rid himself of the conviction that gravity is connected with other forces of nature. 'Gravity—' he said, 'surely this force must be capable of an experimental relation to electricity, magnetism, and the other forces, so as to bind it up with them in reciprocal action and equivalent effect.' He was convinced that as two bodies approach one another, electricity is developed in each. Then, in a moment of hesitation and doubt, if not discouragement, he wrote in his laboratory notes: 'All this is a dream. Still, examine it by a few experiments. Nothing is too wonderful to be true, if it be consistent with the laws of nature; and in such things as these, experiment is the best test of such consistency.' So he continued his efforts to ascertain the facts, but many difficult and tedious experiments yielded nothing conclusive. At this point, feeling that he had done all that he could without time for reflection, he wrote: 'Here end my experiments for the present. The results are negative; they do not shake my strong feeling of the existence of a relation between gravity and electricity, though they give no proof that such a relation exists.' *

"Ten years later he returned to these experiments, having been working upon other problems during the meantime. 'Let us encourage ourselves by a little more imagination prior to experiment,' he wrote in his notes as a sort of personal censor. 'And then he reflects upon the infinity of actions in nature, in which the mutual relations of electricity and gravity would come into play; he pictures to himself the planets and the comets charging themselves as they approach the sun; cascades, rain, rising vapor, circulating currents of the atmosphere, the fumes of a volcano, the smoke in a chimney, become so many electrical machines; for a moment his reveries have the vividness of fact, and he sums up rapidly the consequences of his great but imaginary theory; an entirely new relation of the natural forces, an analysis of gravitation, and a justification of the conservation of force.' Then, perhaps in a moment of exultation, he wrote: 'I think we must have been dull and blind

* Faraday, Michael, *Experimental Researches in Electricity*. By permission of E. P. Dutton & Co., Inc.

not to have suspected some such results.' But he did not allow his imagination to run rampant. 'Let the imagination go, guarding it by judgment and principle, holding it in and directing it by experiment.' When all was done and experiments had been cleverly contrived to eliminate the influence of the earth's magnetism by devices that only his consummate skill could suggest, the results were inconclusive. 'The experiments,' he wrote at the end, 'were well made, but the results are negative. I cannot, however, accept them as final.'

"Faraday's reflections during this period of experimentation have been quoted at some length, because it is doubtful whether a better illustration of the correct method of thinking can be found—clear recognition of the difficulty, accurate definition of the problem, getting the facts, suggestions—the free but guided play of the imagination, with its resulting hypothesis—suspended judgment, and constant attempt at verification or refutation. And there is not other method of thinking, whether it be in science or in the affairs of every-day life.

"Faraday's scientific imagination, keenly sensitive to the meaning of his observations, guessed more accurately than the methods of experimentation in his day could demonstrate; for, to take a wide leap in time, Professor Nipher, of Washington University, has just proved that a relation does exist between gravitation and electrical action. The results of his experiments 'seem to indicate clearly that gravitational attraction between masses of matter depends upon their electrical potential due to electrical charges upon them.' It has long been known that it is impossible to account for the motion of Venus and Mercury by Newton's law. Arbitrary terms, the meaning of which no one understood, had to be introduced into the equation, and Professor Nipher's work shows that what has been called the Newton gravitation constant is not a constant. Its value depends upon the electrical condition of the bodies.

"Returning to the method of thinking, the productive, creative imagination is the mind playing around facts; and the 'little more imagination' with which Faraday thought 'to encourage' himself, 'prior to experiment' was his way of expressing his search for a hypothesis which would stand the test of facts and account for the scientific difficulties which he had discovered. Kepler's discovery, again, that the orbits of the

planets are ellipses was a brilliant guess, but his guess was based on facts—observations—accumulated by Tycho. Upon these facts his imagination played, and to the end of his life he was ignorant of any reasons why planets should move in such curves.

"The way in which a trained imagination uses facts to discover truths is shown in Halley's study of comets. He learned that a comet had been discovered at intervals of seventy-five or seventy-six years, and his disciplined imagination leaped to the conclusion that comets are not chance visitors to the solar system, portending disaster, as had previously been thought. These several visitors, he said, are one and the same comet. So he proceeded to prophesy, but always on the basis of facts. The disturbance caused by the attraction of planets had to be computed. The result of these disturbing influences is that the comet does not describe the simple ellipse that it would if the sun were the only controlling force. Taking all known influences into consideration, Halley found that his comet should reappear at the close of the year 1758 or the beginning of 1759. On Christmas day, 1758, his hypothesis was verified by the reappearance of the expected comet, which passed through its nearest point to the sun in March, 1759. It will be recalled by many that this comet visited us again in 1910, amazingly near schedule time, considering its long journey, and the number of alluring attractions that it encountered in its course. It missed the predicted time by two and seven-tenths days.

"To be sure, matters of every-day life cannot be subjected to the same rigorous examination as can scientific questions, but the methods and precautions are the same. The difference lies rather in the exactness of the method as it may be applied in the laboratory. Perhaps, after all, it is the mental attitude that counts most. Conviction that mere observation is not likely to discover the meaning of a complex situation, ability to hold the judgment in suspense until the matter has been fully investigated, will go far toward reducing errors of opinion and decision."

[Swift, E. J., *Psychology and the Day's Work* (Charles Scribner's Sons, New York, 1918), pp. 51–61. By permission.]

Can the pupil be taught to think, and if so, in what way?

The author of the paragraphs which follow presents an analysis of the activities required for this kind of training.

3. INCREASING THE EFFICIENCY OF THINKING *

"Dewey declares:

" 'A thinking being can *act on the basis of the absent and the future.* Instead of being pushed into a mode of action by the sheer urgency of forces, whether instincts or habits, of which he is not aware, a reflective agent is drawn . . . to action by some remoter object of which he is indirectly aware.' †

"We may surmise from this statement that it is possible to improve one's ability to think just as he improves his ability to read or to speak or to perform the manifold physical activities of intelligent living. Before we consider how one's thinking may be improved we must take up three ways in which ideas may be secured and put in order."

Keeping the Mind Active. "1. Keep your mind active. We have said previously that thinking is a highly active process. Mental experience represents action quite as much as physical experience. We sometimes incline to believe that thinking is passive. But if an individual is awake we may be sure that he is thinking, that there is some kind of mental activity going on. Edison tells us that he made about a thousand experiments before he discovered the right combination which resulted in the incandescent lamp. Columbus worked many days before he went to the convent of La Rabida to induce the prior to intercede for him at Queen Isabella's court. Whenever the efficient individual finds himself in a difficulty, when he is confronted by a problem, he does not sit idly waiting for something to happen. On the contrary, to such a person the difficulty acts as a spur to increase the intensity of his application to it. He may not always reveal in physical expression the degree of this intensity, but if one could look into his brain he would find a multitude of ideas hard at work.

* Werner, O. H., *Every College Students' Problems.* By permission of Silver, Burdett and Company.

† Dewey, John, *How We Think.* By permission of D. C. Heath & Company.

"Observation and testing have revealed that people of high intelligence are usually mentally alert and highly active. They are able to give close attention to an activity for a long period of time. Individuals of low intelligence, on the other hand, are inclined to be phlegmatic and slow in their mental activities. Their span of attention is extremely short. In observing people of this latter type while they were taking the Terman Individual Intelligence Test, the writer noticed that frequently those being examined assumed a reclining position soon after the start and not infrequently fell asleep before the examination was completed. But we find that nature bestows on us a capacity for mental activity if we have normal or more than normal intelligence. It is our business to cultivate this natural gift so that when the perplexities of life occur we may be able to unravel them."

Increasing the Stock of Ideas. "2. Increase your stock of ideas. Since ideas are the 'stuff' with which we think, it is evident that the efficiency of our thinking depends much upon the range and the quality of our stock of experiences. Kilpatrick says that our ideas and concepts consist of meanings. He says:

"'Suppose by some mischance you were to lose your stock of meanings, how would you get on? . . . You couldn't eat, for you wouldn't know food from stones or clothing. You couldn't walk about; you wouldn't know a tree from a hole in the ground or a house from a paved sidewalk. Your thinking would reduce itself to practical zero; you'd have nothing to think with. It is hardly too much to say that you and your world (that is, you as a thinking being and the world as you use it, as it exists for you) consist of the meanings that have been built up in you by all your varied experiences. . . . Meanings are the stuff of which one's thought world is built, and they exist as the means of the conscious control of self and the world.' *

"Kitson also agrees that it is essential to have a large number of facts at one's disposal. If a student is going to reason effectively about problems in history, mathematics, geography, it is absolutely indispensable that he should know as many of the facts of those subjects as he can. Students experience difficulty in reasoning about certain subjects because they are not

* Kilpatrick, W. H., *Foundations of Method.* By permission of The Macmillan Company.

familiar enough with them. Apparently the most effective reasoning in any field will be done by the individual who has had the most extensive experience in that field.

"The enrichment and enlargement of experience therefore becomes one of the major duties of every student. This enriching experience may well be first hand whenever possible. He should observe closely experiences of every kind. He should make trips to places of interest. He should cultivate a wide range of interests in music, art, sculpture, athletics, sports, motoring, and in the animal and plant world. In addition to these direct experiences he should seek such wide vicarious experience as comes from reading books, magazines, and newspapers as well as from listening to music on the radio and the victrola."

Making Ideas Usable. "3. Make your stock of ideas usable. Not only must the efficient thinker have a wealth of ideas to draw on, but he must put this stock in orderly form. One way to do this is to systematize his knowledge by framing clear definitions. A careful thinker has at his disposal a large stock of accurate definitions. Textbooks specialize in clarifying knowledge by means of definitions, some of which a student should learn. Experience constantly affords us opportunities for framing our own definitions, which should be made with great care. Definitions represent mental economy, for they serve as tools with which to expedite our mental activities. The individual who has not worked a part of his stock of experience into clear definitions is like the farmer who does all of his work by hand. The efficient thinker uses his stock of definitions in some such way as the farmer who makes his tools and machinery work for him.

"A second way to put our stock of ideas in orderly form is to classify them. Similar ideas should be brought together in a group. The repetition of the same or similar experience should lead to the formulation of principles of action. The similar and dissimilar elements in our experiences should be noted with great care. The efficiency of our thinking about automobiles, for example, is greatly increased by classification. There are certain points of similarity. All have engines, bodies, wheels, tires, fenders, and so on. There are likewise certain points of dissimilarity. Some have disc, some wire-spoke, and some wooden-spoke wheels. Some engines have four, some six and

some eight cylinders. There are touring cars, sedans, sport models, coupés, and so on. In trying to remember the facts presented in our reading and in lectures, we are greatly helped by outlining, which is a form of classification. In all the activities of life our efficiency is increased by the classification of knowledge. Ideas, like things, should be put in order, they should be placed where they belong so that we may find them quickly when we want them.

"A third way to put our ideas in orderly form is to pay close attention to the manner in which these ideas come to us. The necessity of repeating certain of our experiences before we can make use of the ideas resulting from them springs from our failure to note the experience carefully in the first instance. The method used in solving a puzzle may be taken as an example. The inefficient thinker solves a puzzle largely by accident. He pays little or no attention to the steps by which he did it. When he is asked to solve the same puzzle a second time he must repeat a large part of the original trial and error process. The efficient thinker, on the other hand, watches his moves as he makes them and draws up certain rules or principles by which he can later solve the same puzzle with speed, or a similar one with ease.

"A fourth way to put our ideas in orderly form is to learn them in the way in which we are likely to use them later. The method of learning a foreign language by studing its conjugations, declensions, and vocabulary independently of reading or conversing in it is based on a fallacious assumption, namely, that there is no relationship between either what one learns or how one learns it, and how one uses it later. The way to acquire an ability to read or speak a foreign language is to read and speak it by sentences, the basic unit of thought, and not by learning A B C's, phonic elements, syllables or even words.

"Up to this point the suggestions for improving the efficiency of our thinking have been concerned primarily with providing an orderly stock of ideas, the 'stuff' with which we think. Let us now consider the ways in which our use of ideas may be improved.

"We have previously said that ideas are involved in every kind of mental behavior. The 'stuff' of our day and night

dreams consists of ideas quite as much as does that of our problem-solving and creative imagination. The basic difference between the ideational behavior representing day or night dreaming and reasoning or creative imagination is, as we have said, a difference of control. The former exemplify little or no personal control, the latter exemplify rigorous control to a high degree. The nature of the former types of thinking is determined almost entirely by the stock of usable ideas with which our minds are stored. The efficiency of the latter, on the other hand, depends fully as much or more upon the manner in which we consciously control the train of thought in the direction of solving our problems, creating our inventions, or building our futures. . . ."

Rules for Improved Thinking. "Having secured a stock of usable ideas, we are then ready to give attention to seven rules by which we may improve our thinking.

"1. Feel the need of thinking. One difference between the savage and the civilized man is to be found in the reach of their thinking. The barbarian is content to limit his thinking to the need for supplying the necessities of life, that is, food to satisfy hunger, drink to satisfy thirst, and enough clothing and shelter to protect against inclement weather. But civilized man has extended his need to many other things, and has extended his thinking also to supply everything that he needs. He is not content to satisfy hunger in an elemental way. He fashions dishes and kitchen utensils, he builds dining rooms and dining furniture, he develops a whole science of cookery, he adorns his table and develops wit and sentiment to accompany his eating.

"Dewey believes that the superior thinking of the civilized man may be attributed to his greater ability to keep his curiosity active. He points to the small child

". . . 'reaching, poking, pounding, prying, an inveterate tendency to fool. . . . With respect to curiosity, the teacher has usually more to learn than to teach. Rarely can he aspire to the office of kindling or even increasing it. His task is rather to keep alive the sacred spark of wonder and to fan the flame that already glows. His problem is to protect the spirit of inquiry, to keep it from becoming blasé from over-excitement, wooden from routine, fossilized through dogmatic in-

struction, or dissipated by random exercise upon trivial things.' *

"For far too many persons college life ends in failure because they have no feeling of a need to know, to find out, to enjoy, to grow. Courses become boresome because students have either lost or have never felt the zest of the inquiring mind. They have no overpowering sense of urgent need. It is no wonder that we have to be encouraged to be on the watch for problems that need solving, to fix them in mind, and to assume the responsibility of solving them.

"The truly able thinker is aware not only of his own need, but of mankind's need as well, and he foresees the difficulty involved in setting himself to satisfy it. Nobody told Edison to make his many electrical inventions; nobody ordered Henry Ford to manufacture a motor car whose price would be within the reach of almost every American; nobody ordered Peary to discover the North Pole, or Columbus to find a new route to the East Indies; nobody told Pasteur to take an interest in fermentation and thus discover that bacteria cause many diseases, or James Watt to put steam to work in factories and elsewhere, or Marconi to make use of electric waves in the ether without having to clutter up the whole earth with wires and poles. While all of these men felt an urgent personal need to do these things, no doubt, they felt a compelling human need too, and they shouldered voluntarily the responsibility of increasing the knowledge and the wealth of the world, the convenience and comfort of life, not because they were ordered to do so but because they were alert and efficient thinkers.

"2. Locate the spot where the difficulty lies. The next step of the efficient thinker after he has assumed the responsibility of solving a problem is to proceed as directly as possible to its solution. In the writer's experience with his automobile he instituted a search to discover why the engine had stopped. The trouble was found to be an empty gasoline tank. On a previous occasion it was due to defective wiring.

"In order to locate the difficulty, that is, the problematic element, successfully, one's attention must be highly concentrated. The writer did not fritter away his attention by count-

* Dewey, John, *How We Think.* By permission of D. C. Heath & Company.

ing the passing automobiles nor identifying their makes while he was attempting to determine why his automobile had stopped. His whole attention was riveted on the problem at hand. Headley says:

" 'Search is itself an act of concentration. To hunt is to direct attention. Whether a sportsman hunts for game, a child plays at hide and seek, a miner prospects for gold, or a man of affairs scrutinizes an illegible countenance, the story is the same; every least sign of the thing sought snaps its hold on attention.' *

"The efficient thinker may help himself in locating the problematic element by looking for points in the present problem which are familiar, or in other words, by searching his previous experience. Look first at the spot where a similar difficulty was located on a previous occasion. The reason why the writer looks at the gasoline gauge when his car refuses to go is because he has found the seat of trouble in the gasoline tank before. The garage mechanic, in endeavoring to locate engine trouble, applies a series of tests any one of which, as he has learned from previous experience, may reveal the seat of the difficulty. It is by a process of elimination that the real difficulty is finally discovered.

"The drawing upon previous experience in a new problematic situation reveals the value of a large, orderly stock of ideas. If past experience has been clearly defined and classified, if learnings have been studied and watched for their future usefulness, the locating of a present difficulty will be greatly facilitated. In fact, it is here that the difference between the amateur and the expert is revealed. High ability to locate trouble and to remedy it distinguishes the expert, lesser ability to do so stamps the individual as an amateur.

"After one has located the difficulty he must define it accurately. The exactness of the analysis of a difficulty in most cases determines the pertinency of the suggested solutions which follow. For example, suppose that a doctor makes a call on a patient. His first step is examination, that is, location of the difficulty; his second step is definition, that is recognition of

* Headley, L. A., *How to Study in College.* By permission of Henry Holt and Company.

the difficulty, these two together, location and definition, forming his diagnosis of the case; his third step is prescription to cure the disease. Suppose he finds that the trouble lies in the stomach. Having located the difficulty he must then define it, for there are half a hundred ailments which affect the stomach. The essential element in this definition of the difficulty is the rejection of those things which do not apply to the present case.

"This need of defining a difficulty becomes apparent to the student as soon as he has to make a search for materials called for in a lesson assignment. If, for instance, he has to make a report in a social science course he should, at the outset, state the topic with great definiteness in order to avoid amassing material which is not pertinent. In laboratory work materials with which he experiments have to be chosen with strict care and the experiment has to be performed with absolute exactness if it is to be successful. A careful statement of the purpose of the experiment will be of aid in achieving success.

"3. Suggest solutions. The correct solution to a problem may usually be found in a number of ways. The one by blind trial and error we have already considered. This method is one of the least intelligent although it is undoubtedly the most common even among men. It is the only one used by animals when they find themselves in difficulties. The inefficient thinker regularly does the first thing which suggests itself to him in much the same way that an animal reacts in a predicament. If that fails, he tries something else, and so on until he hits, if he is fortunate, upon the right solution. A second way to solve a problem and the lowest and most contemptible in point of intelligence, is to set others to doing it. Some students spend much of their time imposing their problems on their friends who offer suggestions as to possible solutions. This method is indefensible because it fails to yield any training to the student by means of which he will be enabled to solve future problems which he cannot delegate to someone else. The ability to solve problems is learned by practice just as other learnings result from practice. The efficient thinker welcomes problems, he delights in surmounting obstacles, he revels in verifying his guesses. Still a third way to solve a problem and the most intelligent of all, is to make reasonable suggestions for solutions yourself, then to study

their implications and later to verify their validity and reliability. In other words, your thinking need be neither a blind hit and miss affair, nor yet a search for obliging friends to solve your problems for you; it ought to be a systematic, orderly analysis. The efficiency of the process used depends largely on the kind and the number of suggestions which the thinker makes for solving a given problem.

"Dewey says:

" 'Suggestion is the very heart of inference; it involves going from what is present to something absent. Hence, it is more or less speculative, adventurous. Since inference goes beyond what is actually present, it involves a leap, a jump, the propriety of which cannot be absolutely warranted in advance, no matter what precaution be taken.' *

"He suggests that this activity may be described as supposition, conjecture, guess, hypothesis, and theory. This uncertainity about the outcome of a problematic situation leads Kilpatrick to define thinking as an adventure into the unknown, an expectant look into the future.

"In solving our problems, then, we are confronted with the necessity of making shrewd guesses. May tells us that great minds are all shrewd guessers. Huxley said that the astronomer Kepler was the wildest of guessers. May bewails the tendency of teachers to advise their pupils not to guess, 'and yet we find that the greatest minds of the world have been the boldest and wildest guessers.' Headley says, in similar vein:

" 'We sometimes hear of people who reason "straight to the point." In all literalness no reasoner goes *straight*. If, in any particular case, he appears to do so, you may be sure that it is by accident or, more likely, by employing readymade decisions. Constructive reasoning begins with beating about the bush. The reasoner hunting for suggestions, like the sportsman hunting for game, proceeds indirectly by beating bushes to ascertain what may be lurking there.' †

"Book says that suggestions will come more readily if we per-

* Dewey, John, *How We Think*. By permission of D. C. Heath & Company.

† Headley, L. A., *How to Study in College*. By permission of Henry Holt and Company.

sist in thinking about a problem until we succeed in finding a solution. He also urges us to believe that we can and must succeed. He says:

"'Much * . . . depends upon the attitude which you assume toward your problems. . . . The key to the situation lies in arranging conditions so that you will succeed with every problem that you try to solve. This may be accomplished by suitable encouragement and by practicing with relatively simple problems until the habit of trying patiently until you think of the right solution has been established. Nothing can take the place of this habit of believing that you really can solve all the problems you encounter, for this attitude makes it possible for you to keep on trying until the proper suggestion appears, and until a successful solution to your problems is found.'

"4. Study the implications of your suggestions. In the writer's experience with his stalled automobile he debated the merits, you remember, of a number of suggestions, to determine the best line of action to take. He might hail a passing car and ask for gasoline, but he abandoned this proposal as taking too much time. He had only fifteen minutes to spare, and it might take every moment of that time to find a driver who would be willing to help. Such a process of weighing the merits of a proposed solution is referred to as studying the implication of such a suggested solution. The inefficient thinker does not take this step of weighing the values of suggested solutions. When a suggestion comes it is immediately seized upon and put to work without studying its probable effect.

"Such a weighing procedure tends to eliminate our bad guesses or poor suggestions. May tells us that great minds, in addition to being shrewd guessers, are also ruthless eliminators of their wrong guesses. 'This † is the mark of the true genius. Anybody can guess, but it takes a great mind to devise means of checking the guesses.' He calls attention to the fact that although Kepler was the 'wildest of guessers,' he considered, at the same time, no labor too long or too arduous by which he might test his reasoning or conclusions for errors. The will-

* Book, W. F., *Learning How to Study and Work Effectively.* By permission of Ginn and Company.

† May, M. A., *How to Study in College.* By permission of University Press, Syracuse University.

ingness with which a discoverer organizes means for speedily, thoroughly, and pitilessly testing his conclusions indicates, to a considerable extent, the degree of his genius. Michael Faraday, the father of the present electrical age, once declared,

" 'The world little knows how many of the thoughts and theories which have passed through the mind of a scientific investigator have been crushed in silence and secrecy by his own severe criticism and adverse examinations; that in the most successful instances not a tenth of the suggestions, the hopes, the wishes, the preliminary conclusions have been realized.' . . .*

"5. Come to a decision. After your mind has offered suggestions and after you have balanced their implications, it is necessary to make a choice among them and to decide upon which one to act. The world hates a vacillating individual who does not know his own mind, who is forever 'on the fence.' Thinkers may be divided into three classes according to the manner in which they arrive at their decisions. First, there are those who make decisions hastily without either considering a sufficient number of suggestions or studying their implications. These are the guessers, the thinkers who jump at conclusions. Second, there are those who take under consideration many suggestions which are not pertinent to the problem. They spend too much time in a study of the implications, largely because they anticipate consequences which do not materialize. These are the theorizers who are tardy in reaching decisions. Third, there are those who propose a number of pertinent suggestions, study their implications and then make a definite decision. The third class constitutes the efficient thinkers.

"6. Test your decisions. The final test of a decision is of course whether it actually solves the problem. Cunningham states that 'no problem is solved until the answer is checked.' † This is true in all problem-solving situations, not alone in mathematics. Kilpatrick shows how modern civilization has been built on 'tested thought.' Beginning with Galileo in 1590 the theories of philosophy and science were more and more put to the test,

* Faraday, Michael, *Experimental Researches in Chemistry and Physics.* By permission of E. P. Dutton & Co., Inc.

† Cunningham, W. H., *Character, Conduct and Study.* By permission of G. P. Putnam's Sons.

first by observation, then by experimentation. Thought, so Galileo insisted, to be acceptable must be tested by its observed consequences. Such testing of thought made inventions possible. It encouraged extensive and intensive discovery. The result of this testing of new ideas is a body of reliable thought and an increased confidence in the possibility of solving problems which have puzzled men for centuries. In the same way the efficient thinker is not content merely to reach a decision: he must test his decision by practice. If it stands the test, he acknowledges it as the object for which he sought; if it does not stand the test, he renews his search for other promising suggestions.

"7. Keep an open mind. Hesitancy to accept a decision until it has been tested by experience suggests again the desirability of cultivating an open mind. The open mind puts decisions to work to fill present needs but it never assumes that these decisions need never be modified as a result of later experience. New experiences may throw new light on the problem. Continued action on a decision may reveal flaws in its quality."

[Werner, O. H., *Every College Student's Problems* (Silver Burdett and Company, New York, 1929), pp. 245–257. By permission.]

QUESTIONS

1. Give an illustration of a complete act of thought from your own experience. Point out the five steps in the process.
2. Show the part that perplexity plays in thinking.
3. Discuss the value of suspended judgment in thinking.
4. At what points in Dewey's five steps do we find processes of induction and deduction?
5. Show how imagination plays its part in thinking.
6. Give a series of rules for increasing efficiency in thinking.
7. How may ideas be put in orderly form?
8. Discuss the relation between curiosity and thinking.

CHAPTER XIII

TRANSFER OF TRAINING

The opposition of views represented at their extremes by the doctrine of formal discipline versus the doctrine of specific learning is due fundamentally to a difference of conception as to the nature of mind. Professor Stratton in an article entitled "The Mind as Misrepresented to Teachers" shows that both these extreme views are incorrect.

1. THE MIND AS MISREPRESENTED TO TEACHERS

The Faculty Conception of Mind. "The child's mind, according to one account, is a group of wide powers or faculties,—of observation, for example, and memory, attention, imagination, reason,—which the teacher, by suited exercises, must make strong and supple. These great powers, once they become vigorous and elastic, stand ready throughout life for all important needs. Time is well given to their development, even by studies that in themselves will never be of use. The particulars needed for one's work are too many to be foreseen, and, with a prepared mind, may easily be learned when the need is clearer. Powers have been given new life, not only for buying and selling and medicine and law, but for still wider service in regions where the day's work will never lead.

"Those who so believe, their opponents say, are suckled in a creed outworn. Science has destroyed the simple faith. Experiments by James, Thorndike, Woodworth, and others have shown how idle is the attempt to train these general powers; have shown, indeed, that there are no general powers to train. The belief in such powers goes with the antiquated idea of mental faculties, now of historic interest only, and swept aside with phrenology and its absurd map of the skull and brain."

Mind as Sum Total of Particular Capacities. "Having destroyed in this way the faith in general powers and their train-

ing, what is offered in its place? A belief in particulars, and in particulars only. Instead of a single power of memory, there is a power to recall colors, another power to recall sounds, and so on—we know not how far. The mind is our convenient name for countless special operations or functions. We may train one of these functions or a number of them, but not a function in general—attention in general, or imagination in general, or reason. Further, these countless particular functions are independent; and when you have trained one of them, you have trained that limited function and none else. What you do to the mind by way of education knows its place; it never spreads. You train what you train.

"The educational corollary of these things is momentous. We must discover the specific reaction, the specific information, which the child will use in after life, and make sure that he possesses these and only these. The teacher's direction of attention here veers from east to west. The center of interest is no longer the child's mind, but the particular things in life that have to be done. Of a study, we are to ask, 'Does it contribute to the doing of these things?' rather than, 'Does the study make the child's mind more alert or sound or sane?' Instead of giving form to the mind, we are to give it information. Instead of moulding the mind, we are to fill the mind. Where the education whose aim was mental discipline might have as its symbol a stripped athlete busied with Indian clubs and chest-weights for strength and agility, the education that opposes mental discipline and calls for mental contents might have as its symbol some receptacle that is being filled,—a jar, with oil or wine; or a tool-chest, with screw-driver, chisel, and plane. . . . "Let us ask whether it be true that practice keeps its place, that you train only what you train."

Spread of Training. "The experiments in clear support of this doctrine are few; most experiments contradict it. Improvement in judging the area of certain figures . . . fails to bring equal improvement in judging other figures. But the judgment of these other figures is not left untouched. On the contrary, it receives marked benefit. And while one experimenter found that neatness remained within narrow limits, another found that it could easily be made to pass such limits: if the children, in writing their arithmetic lesson, for example, were urged to

neatness as of universal value, their papers in geography also were neater, although this other subject had not been named in the urging. Or, again, Swift practised with the right hand the tossing and catching of balls, keeping two in the air at once, until he had attained a high degree of skill. And now, was it with the right hand only that the effect of the practice appeared? No; it appeared also with the left; in some cases it was as if fully two thirds of the practice had in some way been transferred. And in many other directions of research, transfer of training is found.

"It will hardly be possible to follow the attempted explanations of this spread; it can hardly be explained away. And even a spread of small amount may be important: the effort would be well repaid if practice in justness of conduct at school were to bring even the slightest increase in justice of conduct in all other relations of life.

"The evidence from the laboratory thus shows that the mind is unlike land, where ploughing of a field does not affect the soil beyond the fence. But the evidence is not confined to the laboratory. It is known, for example, that a left-handed child trained to act as if he were right-handed may stutter, and, becoming embarrassed, may incline to remain alone. The repression thus may work disastrously even into distant regions of the mind. And we are only at the threshold of our knowledge of the brain. Indeed, it is impossible to say that a serious effect in one part of the brain-cortex ever leaves the rest of the cortex unchanged; the change may be greater here than there, but never circumscribed.

"Instead, then, of proving that you train what you train, the psychological experiments which have so troubled the waters of education prove that normally you train what you don't train."

The Generality of Responses. "And now, is it true, as the partisans of 'contents' maintain, that our mental powers are stubbornly particular, and never of general use? One would almost think, from some accounts, that a mental function could be trained for little more than one occasion, like the bow upon presentation at court. Yet even so particular a response as that of answering the telephone is run through and through with generality. There is never quite the same signal, never quite

the same movements of the body, never the same words spoken, never in the same tone, never to the same purpose. If one cannot but see the breadth and openness in even so restricted a habit as this, how much more clearly general is the other habit of assuming a fighting attitude toward difficulties, of asking evidence for any universal assertion, of giving special heed to the side opposed to one's private interest. These habits of mind, and a host like them, are perhaps less wide than the memory in general, or the reason in general of the older education. For us, the important thing is to see their immense range of use, in all manner of situations and by all manner of men, whether day laborers or diplomatists.

"So far we have been busied in denial, and denial by itself profits little; it should be the prelude to something more positive and gracious. Let us, then, look more directly upon the mind itself, to see, if possible, its more acceptable constitution, noticing our disputants only at times and out of the corner of our attention. Their artificial divisions into faculty and function in time tone down to their true value, as in the picture of the dissected muscles of eye and cheek and forehead, which we have to correct, knowing that these ghastly members are in life fed with warm blood, clothed with soft skin, and controlled by affection and intelligence; and in their stead we have a human and expressive face.

"The mind is capable of wide forms of action; if we pursue this idea we come upon pleasant scenes. We come upon Lincoln, with his habit of 'bounding' every important idea in his use, never at ease until he saw clearly what limited it on the north, south, east, and west, with no borders lost in the mist. Such a habit is of use for any idea and for anybody. Because it is not the whole of reason, we must not be blind to the part it can play in reason, immensely wide, even universal, in its sweep."

The Need for Special Knowledge. "Yet we must also see the need for special knowledge. If one is to think effectively of sugar beets, or airplane engines, he must study such beets, such engines. But he will not think effectively upon these if he thinks of these alone: his interest and his knowledge must widen to the principles of agriculture or of aërodynamics; and, beyond, he will need botany, or physics, and chemistry. Chemistry, then,

is important for a lad uncertain whether he will deal with beets or engines. But what of the boy or girl who does not know, and whom no one as yet can tell, whether beets, engines, taxation, tuberculosis, or the Gospel will lie at the center of his thinking in the time to come? Must he give laborious years to all these and to a thousand things besides, that he may be ready for the day of action? Inevitable and enormous waste is in that direction. He had best be at home in the central studies into which all special subjects lead; and with these, and even more useful, he will need habits of intellectual economy, of accuracy in interpreting what is read and heard, of distinguishing important from unimportant, of throwing himself with vigor into the work in hand. These are a part of intellectual training; these and other things take the place of the two or three faculties of the older belief. They stand out as significant to an eye bewildered by the endless array of special functions that for some are the only thing left. These wide and superior powers call for training, and the lad who has them trained has an incalculable advantage over every lad in whom they remain untrained.

"But were we now to look to the energy of the mind, we should find something still wider than these, evident, not only in our thinking, but in every form of will. This energy makes itself known in the strength of the man's attention, in the vigor of his intellectual attack, and out beyond intelligence, in his endurance, in the impact and tenacity of his purpose. Its amount is not the same as the amount available, which suffers changes not due merely to the ups and downs of health. Some crisis, as all know from *The Energies of Men,* may open a hidden reservoir from which power now flows into a man's every act. In the war, men and women who had before been working to their utmost suddenly assumed duties that doubled or even trebled their task. No new function may have been called to life, but rather the long-familiar acts felt an access of energy; and in this store of energy connected with all functions, whether they be special or general, we have an intimation of the mind as of another plan from what has too often been taught. It is not a mere composite of general faculties, or of particular functions, but something single, yet varied, holding together all functions and energizing them with a common life."

The Emotional Aspect of Mind. "The release of pent-up energy lies close to the emotions; and in them we shall discover changes deep and wide—changes that reveal new possibilities of education.

"For the fruit of every one of our intellectual powers is markedly affected by the emotions behind them and interfused with them. There is a whole group of passions which, in certain forms and intensities, are strength-giving—hope, for example, and gladness and anger and fear. To these we should doubtless look for the cause of that opening of the gate of energy in crises when energy is our sorest need. They make and unmake the man. They hold our powers together; they disorganize and disrupt. The war has brought new illustrations of this, when emotional stress and strain, without wounds, have caused the soldier to be blind or deaf, unable to speak even his own name—great stretches of his past a blank to him. A like influence of emotion upon the total organization of the mind has long been observed in hysteria, with its functional blindness and deafness, its functional paralyses, its disturbance of memory and of the very feeling of one's identity. In all these cases something beneath the special functions has broken, and for the time their cunning is gone. Their life, then, is clearly not in themselves: in part, at least, it wells up from deeper sources.

"The play of emotion thus reveals the mind. If its powers seem stubbornly specialized and separate and insulated, this is true only in part and on the surface. Deep within we find free intercourse, free circulation. For all its particularized abilities, then, the mind is whole and fluid. A passion acts in it like a drop of strong chemical that causes ebullition or precipitation throughout the whole. We cannot afford to neglect these universal potencies. The sect called Christian Scientists, with its eye upon some of these energizing emotions, shows that the neglect is being noticed and avenged. And the growing attention to play is something of a belated redress. We once thought that health and mental vigor needed mere muscular contractions—so many foot-pounds of exercise per diem. The spirit of play in the exercise is the secret elixir, and with it apparently the exercise can almost be spared. Some day we shall know how much the great and balanced workers owe to their power to play—in mind if not in body. Wilson, like Lincoln, enjoyed

the theater; and humor was a grace of each. With a right grasp of the mind's character the emotions will come into their own. Time and some impatience will bring us to share the conviction of the wise physician, Sir James Crichton-Browne, that in all education these need uncommon care; but that, even for special work in medicine, the right and sensitive emotions of the physician himself can alone give effect to his learning and his judgment and his skill of hand.

"But the energies and the emotions are not the only regions neglected both by those who would give mental discipline and by those who would give mental contents. The instincts and the will cry out their own neglect. And this is the more important, for they too lead us beyond the thought of independent functions and faculties, until we see the mind's worth as something decided largely by the quality of its organization, and see that this organization can be directed toward the better or the worse. The neglect and the opportunity here invite longer consideration.

"All children, if we look closely at their conduct, show a number of inborn traits—among others, an interest in possessing things, an attachment to other persons, a desire to shine in one's own and in others' eyes, a curiosity, a driving toward contention and domineering. And according as these impulses are bound together in one or another way, there result persons who stand opposite one another like day and night.

"In one kind of youth, these various impulses act almost in independence. In another, they are bound until either the life is almost crushed out of many of them, or they are all made slaves of one of their roughest number. In still a third, the impulses are strong and united, but in a freer way, keeping watch upon one another; no one of them can stir without ears pricked up in all the rest; and its behavior is subject to their urging and restraint. But our present youth is indeed fortunate youth, for in him the sense of attachment to others, expanded and refined into obligation, speaks the last word to all the competing interests. The native impulses have been brought to their place and proportion, each active, each tempered by its neighbors, each contributing to the right expression of the whole, each trained, like the soldiers of the Tenth Legion, both to command and to obey. Such training is both private and social.

The individual is enriched and also the community. For, in a man so trained, the instincts that either devastate or upbuild our common life, the instincts of pugnacity and of sex, have become, not enemies, but friends, of the general good.

"Now the possibility and the need of this care and organization of vital instincts into a right form of will hardly appear in many a picture of the mind. Neither a group of independent faculties nor a group of independent functions reveals this constitution and opportunity. The metal disciplinarian, all eyes upon observation, memory, and reasoning, would strike into the depths of intellect, but misses those still lower depths of the affection, the instincts, and the will. Advocates of contents declare that the mind needs no care for its form and organization: it needs only to be filled."

Intellectual Conversion. "We might as well regard the mind as inviting, and indeed requiring, not only particular training and useful information, but also a profound redirecting and strengthening of its inner order, not wholly unlike religious conversion. Such a change will usually not be sudden, or marked by emotional storm; but gradually and in calm there will come a new perception and a new attachment of the affections and a striving toward a new goal. Something like this is in Plato's thought, that true education is that which leads us always to love what we ought to love and to hate what we ought to hate, from the beginning to the end.

"Changes in the direction of the affections, even changes that seem instantaneous, are not confined to religion, but are general possibilities of our nature. The interest which in such cases turns the man around has, of course, not been created on the instant: it was active all the while, but subordinate; and the conversion is but the final stage of a long struggle within. A new ordering of old interests and impulses has at last come, and a new stability is the result—as with an iceberg that by long melting below the ocean's surface must find a lost balance, and with a plunge shows a new side.

"Such changes with most of us, when they occur, are less cataclysmic, although no less real and profound. They are invited in early childhood and in the years when school and college are working in us good or ill. No system of education can afford to miss them and the constitution of the mind which they

imply. The mind, as we study it, begins to reveal an immensity and an inner life hardly dreamed of by many who repeat solemnly what they take to be the final word of science. Each man's mind is as varied and deep and wide, in its own way, as is the physical world. Its soundings and its sweep will forever exceed description, yet we can already dimly discern some of the forces that bind and move and strain the whole—a view which does not contradict, but corrects, those who notice only what is local and who miss the infinite in the infinitesimal.

"But some, while admitting that the corrected account of the mind may interest those who happen to be interested in such things, will deny that it is important for education. We must forever go on storing the mind, exercising its separate functions or faculties, they will hold, not because this alone is good, but because it alone is possible. 'How,' they will ask, 'can we unlock the child's reservoir of energy? How can we make his emotions strength-givers indeed, and not his ruin? Is it possible to enter among his wild instincts, leaving them no longer to howl in anarchy or under despotism, but to be a commonwealth guided by the best?' "

The Teacher's Task. "The task is indeed difficult, and demands the talent of creative artists. Not in one generation or in two will the means be discovered and brought to bear. But whatever comes of the best family life, or of fortunate friendships, or of great public opportunity and need—whatever comes to the mind's benefit from these is clearly within the aim of a right education. Whatever can be wrought by happy environment can in some measure be wrought by the school, which, too, is an environment planned and chosen. The result may be of less amount than comes from beyond school, but it need have no different quality. And most of all, where the world beyond school promises the child not the best, but only the worst family life, with no fortunate friendships, and only the bleak prospect of factory and mill and mine, then is the demand insistent that we neglect nothing that will even slightly remake the mind into what is right and whole. The shame would not be so great were we to recognize the demand and our own incompetence. There would be some honor in feeling the lack, in hearing the challenge to the search, in being restless until the great discovery.

"Once recognize the demand, and the inventive will of man

is indomitable. So in education we shall have faith in things to come; we shall welcome all manner of experimental schools, especially those that look steadily to true understanding and to the will and the affections; out of those are the issues of life. Effectively to love what ought to be loved, and to hate what ought to be hated, requires, not heart alone, but brain and hand and tongue.

"When we are offered new lamps for old, we must test the new to see how much of the old Aladdin-magic they contain. Let us have the new with the least loss. The cry for special training is a cry for specialists; and desirable as they are, they will bear watching, for in choosing them the temptation will be to ask only what and how much they know. Moreover, with specialists it is touch and go with their pupils. In the great city schools there is little of the leisurely contact, little of the intimacy, without which the imparting of useful knowledge is as sounding brass. The archaic teacher, who taught the same children everything that lay between Shakespeare and the rings of Saturn, at least became acquainted with his pupils, and little in him escaped their ferret eyes. Upbuilding can come only from those who have it, and the demand for it must not weaken the demand for the expert in his field. An erect mind knowing the salient things will do more to quicken and give a right facing to other minds than will a dozen husks of humanity with the entire alphabet in capitals after their names.

"Instead, then, of following whole-heartedly the new lights of education, whose gospel is that subjects are more important than minds, we shall reaffirm the exact opposite, while yet opening the door to the useful. The child is bigger than anything he can carry to market. In him is a divinity ready for employment, but greater than any employment he will choose. In fitting him to his job, we must have a live child left. This means no slighting of details: his general-powers must be brought down to particulars, and to particulars that are useful. If the child be more than his information, we shall not neglect his taste. He will be sensitive to beauty, but by some toughening of his fiber he will escape daintiness and a repugnance to what is wholesome and of the soil. He will know the way into the enchanted world of music and painting and literature, but with a strengthened grasp of common duty; he will not treat lightly

what he owes to family and friends, and to plain men everywhere.

"And he will have reverence. This great completion may not aid him as a producer of commodities; it may even hinder. But, as Dr. Cabot has reminded us that some of the greatest things in life are unhygienic, so we shall not forget that some are uneconomic. Man, as was said of old, is indeed the great amphibian. He suffocates if kept from the upper air. There must be intercourse with uses great and small, but also with that great world which passes judgment upon all use.

"No symbol does justice to the mysterious relation between the mind and him who helps it to its power. The teacher is like a physician, assisting at the birth of the mind—the mind, which, before, exists all cramped, not breathing as yet. But he also feeds the mind, guides its first steps, gives it gymnastic, gives it toys and tools. He is the mind's autocrat, but an autocrat who knows when revolution is due, and abdicates; so wise that he has provided against anarchy, has trained many for office, and trained others to recognize them; so that self-government moves quietly into the departed ruler's place. No symbol is adequate; but should we not be shrewd bargainers if we exchanged both the image of the stripped athlete with the Indian clubs, and the image of the tool chest well stocked, for the figure of a city-state, with its inhabitants becoming trained to artisan tasks, trained to build and enjoy parks and museums, theaters and sanctuaries; trained also to enter and to respect the massive halls of justice and lawmaking and command? At home in all these broad spaces, he who is bringing into order the great city pauses here for a moment and encourages, passes on and sits down and patiently guides; and in the end, and with many helpers different from himself, and with a favoring fortune, the republic of the mind is established, and unfurls its splendid banner with festival and song."

[Stratton, G. M., in Holmes, H. W., *The Path of Learning* (Little, Brown & Company, New York, 1926), pp. 220–222, 225–236. By permission.]

The number of experimental investigations that have been made of transfer of training is very large. A summary of a selected group of these investigations, made by Professor Whipple, is submitted at this point. Familiarity with this concrete

material is necessary for proper understanding of the subject. The student should compare the results of the experimental work with the conclusions drawn by Whipple at the end of the article.

2. SOME TYPICAL INVESTIGATIONS OF TRANSFER AND THEIR RESULTS

"*Studies Dealing with Memory.* (a) James. In his Principles of Psychology (1890), Vol. 1, pp. 666–7, James reported the effect of training in memorizing a certain kind of material upon efficiency in memorizing other kinds of material. He was led to conclude that there was no transfer of training, that one's native retentiveness is unchangeable, that no amount of culture modifies a man's *general* retentiveness. This work of James represents, of course, a pioneer exploration. The experiment was loosely organized; in particular, as has already been noted, there was no control group.

"(b) Peterson. The difficulty just mentioned in James's work was recognized in the repetition of the experiment in 1912 by Peterson, but his data were too meager to permit reliable conclusions; in fact, three of the unpractised subjects gained as much as one of the two practised subjects; nevertheless, we find Peterson saying that 'there was certainly a large transfer of training here' * (referring to one subject).

"(c) Ebert and Meumann. The experiments of these investigators at the University of Zurich on from 2 to 6 laboratory subjects dealt with the effect of memorizing series of nonsense syllables upon efficiency in memorizing various other sorts of material. These experiments are of interest because the investigators claimed to have demonstrated the existence of a very large amount of transfer, explained not only as due to increased capacity to attend, better technique in learning, etc., but also as due to a hypothetical 'sympathetic interaction of allied memory functions.'

"(d) Dearborn. The repetition of the work of Ebert and Meumann by W. F. Dearborn, then of the University of Wis-

* Peterson, H. A., "Note on a Retrial of Professor James' Experiment on Memory," *Psychological Review*, Vol. 19, November, 1912. By permission of The Psychological Review Co.

consin, showed that a large portion of the transfer effect alleged by Ebert and Meumann was due to the gains made within the test series and that the remainder could be attributed to general improvement in orientation, attention, and better technique of learning.

"(e) Fracker. A careful piece of work by Fracker, from the laboratory of the University of Iowa, in 1908, dealt with the effect of training in remembering the order of sound intensities upon efficiency in remembering the order of various other materials. Fracker's results are regarded by him as furnishing clear evidence of transfer under certain conditions, provided 'transfer' is thought of not as a mere 'spread' of training, but as ability to use in a second situation a content or a form of procedure that is identical with the one trained. There is little spread of training without this identity of form or content. Ability to organize facts by conscious use of imagery, for example, is transferable, and it seems probable that it is especially in identical elements of an ideational sort that the carriers of the training effect are to be found.

"(f) Winch. In 1908, and again in 1910, W. H. Winch, of London, reported one of the first attempts to study transfer on children working under normal schoolroom conditions and with special pains to classify the subjects into two groups of equivalent ability. Winch's experimental groups were trained in rote memorizing of poetry or of meaningless things and the effect was measured that this training produced upon the memorizing of other forms of material. He construes the results as indicative of a real transfer of training; however, the amount of transfer cannot be regarded as great when proper allowance is made for the operation of chance and for certain features of method and material used in the study.

"(g) Sleight. One year after Winch's second paper appeared another English investigation, that of Sleight, in which 12 year-old school children and also adults in the laboratory were given training in memorizing poetry, arithmetical tables, and prose substance and were tested for the effect of this training on other forms of memorizing. The results give only slight ground for claiming transfer. The 'area' affected by special training is quite narrow, and if training does occur through the presence of identical elements, the identity must be very close and must

include identity of procedure, of imagery, and of logical organization. In particular, the mere presence of an identical element is not sufficient to produce transfer; the element must also be usable by its possessor. Furthermore, a considerable degree of similarity between bits of content may be entirely ineffective as a basis for transfer if there also exists an important difference in the two procedures. Again, there may appear actual interference with a latent tendency toward transfer if the second activity chances to be unpleasant for the subject. There is no 'general memory faculty' and no generalized training of attention.

"(h) Woodrow. Quite recently there has appeared a study of transfer of memory training conducted by Woodrow upon three groups of university sophomores. The 106 students of the Control group took only the beginning and end tests; the 34 students in the Practice group were given straight practice in memorizing poetry between the two tests; but the 42 students in the Training group had, in addition, specific instruction in the technique of memorizing and in applying this technique. The second group (practised) were sometimes better, sometimes poorer than the first group (control), but the third group (trained) averaged in the end tests 31.6% more gain than the control group. Woodrow says that 'to determine the amount of transference of ability that did result from the study of a particular subject is one thing, to determine the amount of transfer which *might* be secured from the study of the same subject is a different and far more difficult thing.' The experiment, he thinks, shows the difference 'between unenlightened drill and intelligent teaching.'

"This study does seem to me especially interesting. It would seem to support the contention of those who ascribe particular significance to generalization as the vehicle of transfer. What appears to have happened is that the merely practised students failed of themselves to educe adequate general principles governing the technique of memorizing, whereas these were supplied by the instructor to the Trained Group. On the other hand, the question may be raised as to whether we are really dealing with a problem of transfer (in the usual sense) if we simply demonstrate that direct instruction in a technique of intellectual procedure can afterwards be employed by intelligent mature

students in various concrete situations. In other words, Woodrow should have shown us what amount of improvement could have been secured by instruction but no practice.

"*Studies Dealing with Perception, Discrimination, and Apprehension.* (a) Thorndike and Woodworth. In their laboratory experiments reported in 1901 these authors trained from four to six laboratory subjects in estimating small areas, weights or lines and in the perception of certain letters and parts of speech, then measured the effect of this training upon the estimation of other areas, weights, and lines, and the perceiving of other letters and parts of speech. Despite the close similarity of the training and the test series, the general quantitative outcome indicated a comparatively slight transfer of training, and there were evidences of interference (negative transfer) under certain conditions. The authors of this often-quoted study contend that there are no such 'general' functions open to training as attention, accuracy, or power of observation, and that whatever transfer takes place does so by dint of the presence of identical elements in the influencing and influenced functions.

"My criticism of this contention has already been foreshadowed. Why expect academically trained adults to be open to further improvement of such 'general functions'?

"(b) Judd. While working in the Yale laboratory, Judd trained two subjects in the Müller-Lyer illusion and found that, by dint of practice, and without the aid of abstract judgment, the illusion gradually disappeared, and that the practice-effect was transferred. The effect was ascribed to perceptual training.

"(c) Coover and Angell. Six subjects trained in introspection were used by Coover and Angell in their investigation of transfer in the field of sensory discrimination. The effect of training in the discrimination of sound intensities was found to transfer to the discrimination of grays, but this result is supported by assertions based upon introspection rather than by any clear statistical demonstration, since the two control subjects seemed to improve as much as the four experimental subjects.

"(d) Whipple, Foster, and Dallenbach. The experimental work of these three, all studies from the Cornell Educational Laboratory, may be presented conjointly. In all three investigations the material consisted of drawings, lines of poetry, num-

bers, groups of objects, and the like, exposed to view very briefly.

"The work of Whipple and of Foster was limited to laboratory tests upon competent adults. The general outcome was that there was no improvement of any basic intrinsic ability, like attention or apprehension or visualizing, that the superficial improvement was very specific and explicable as due to habituation to the setting of the experiment, to special 'tricks' or techniques rapidly acquired during the experimenting, to the development of confidence, etc.

"In the work of Dallenbach, however, when similar rapid-exposure practice was given to a class of third-grade school children, not only was there a marked practice-effect, but also evidence of the transfer of this effect, brought out more especially by retesting after 11 months in comparison with untested pupils. Dallenbach concluded that the training had permanently altered and modified certain mental traits; in other words, that such exercises as Whipple and Foster found to be ineffective in altering the basic capacities of adults were really effective in making such alteration in children.

"(e) Ruger. Either in this section or the next may be classed the investigation conducted by Ruger at Columbia University. By employing 37 mechanical puzzles and by minute records of the subjects' work, Ruger was able to observe to what extent solutions arrived at in given puzzles were transferred to the solution of other puzzles of varying degrees of similarity. The outcome of this study seems quite unlike that reported by Judd in the practice with illusions of length, for Ruger concluded that the presence of imagery was of no avail without conscious generalization of methods of attack and analysis. Other factors making for transfer were ideals of efficiency, attitudes of 'high-level attention,' satisfaction of success, etc. 'The value of specific habits under a change of conditions depends directly on the presence of a general idea which would serve for their control.' *

"(f) Wang. Somewhat similar to the study of Coover and Angell is that carried on at the University of Michigan by a Chinese student, Wang, who trained a small number of pupils in discriminating the lengths of vertical lines and tested the

* Ruger, H. A., "The Psychology of Efficiency," *Archives of Psychology*, No. 15 (1910).

effect of this training upon their ability to discriminate pitch, to discriminate shades of color, to discriminate sizes of figures, and to mark words containing certain letters. Wang found that no transfer appeared unless the children were able to develop an efficient method in the training series and to use this purposefully in the test series.

"*Studies Dealing with Voluntary Effort and Motor Adjustments.* (a) Gilbert and Fracker. One of the earliest studies in this field is that of these two Iowa investigators, who worked in the laboratory with the stock forms of reaction-time. For their three subjects large amounts of transfer-effect were noted; thus, practice in simple sound reaction reduced the time for simple reaction to other stimuli almost as much as it reduced the time for the sound reaction; similarly with practice in discrimination reactions, but practice with the former did not affect ability in the latter. It must be evident that the general setting of the reaction test is so similar for the various types of reaction that one would expect such an improvement as was reported to occur through such external or indirect factors as habituation, acquiring favorable set, etc.

"(b) Blair. In the Columbia Laboratory, in 1902, J. H. Blair, in connection with various experiments on the practice curve, encountered situations permitting a study of transfer, e. g., the effect that training in tapping rapidly on the typewriter a given series of exposed characters had upon speed of tapping other series, and again, the effect that training in reciting the alphabet rapidly under certain conditions had upon reciting it under other conditions. The general outcome of Blair's work was evidence for a definitely transferred practice-effect: 'one kind of practice helps us in another kind.' * Blair also reported numerous interference effects, and it is of interest to note that interference often lessens as practice continues, until it disappears and the transfer may then become positive and favorable to the new activity.

"(c) Coover and Angell. In the investigation by these authors that has already been mentioned, an experiment was included in which subjects were trained for forty days in the rapid sorting of cards. This training was said to have definitely

* Blair, J. H., "The Practise Curve," *Psychological Mon.*, No. 19 (1902). By permission of The Psychological Review Co.

increased their efficiency in certain aspects of typing. The investigators designed this experiment to eliminate all identical factors and hence ascribe the statistical improvement to certain 'general' factors, like equitable distribution of attention and development of power to concentrate attention throughout an entire series of reactions. This is one of the few studies in which a claim has been advanced for such training of a general function.

"(d) Wallin. The experiment of Wallin, in which two subjects were practised for 60 days in controlling with one eye illusions of reversible perspective with the result that this practice was found to be transferred to the other eye, may be cited as a typical instance of the so-called 'cross-transfer of training.' It seems obvious that the training occurred primarily elsewhere than in the used retina, so that its effect would naturally appear when the previously unused retina was employed. The same remarks may be made concerning Wallin's further observation of transfer from foveal to peripheral perception of these illusions.

"*Studies Dealing with Schoolroom Activities and Attitudes.* (a) Bagley, Squire, and Ruediger. An experiment planned by Mrs. Carrie Squire and reported by Bagley concerned the transfer of a habit or ideal of neatness from one branch of school work to other branches. This led Ruediger to investigate the matter further a few years later.

"The Bagley-Squire work seems to have been seized upon as a basis for pedagogical generalizations that far exceed its warrant. In substance 'the test consisted simply in insisting on neatness and accuracy in the preparation of arithmetic papers by pupils in the latter half of the third grade.' Three weeks' persistent drill produced definite results in these papers, but no results, save a slight loss, in improving neatness in the language or spelling papers. The contrast was 'almost startling.' Drill in specific habits of neatness did not produce a general habit of neatness.

"In Ruediger's subsequent extension of the neatness experiment the specific training in neatness in one school subject was supplemented by talks on neatness elsewhere (in dress, in the home, etc.). Small gains appeared in neatness, not only within the school subject specifically trained but also within other subjects. Ruediger stresses in especial the operation of conscious

ideals as an important factor in effecting the transfer of the habit.

"(b) Winch. In addition to the investigation previously mentioned, this British investigator undertook several studies of the transfer of training in numerical accuracy in school children. In the first set of experiments, of the four studied, there was no transfer in one school, but definite transfer in the other three schools. The transfer here consisted of the effect of training 'in working rule sums' upon subsequent accuracy in solving arithmetical problems. In the later study, in which 36 ten-year-old boys were given ten practice exercises in numerical computation, this group did not surpass the unpractised control group of 36 boys in subsequent tests of ability to solve arithmetical problems rationally (but without actual numerical calculations), that is, drill in computation did not transfer to skill in problem solution. Of interest in this investigation is Winch's demonstration that the existence of a high positive correlation (0.85 in one case) between these two abilities does not permit us to argue to a causal relationship such that the improvement of one of the related abilities necessarily produces improvement of the other.

"(c) Starch. Though carried on (presumably) in the laboratory with college students, we may class among the studies of school activities the study reported from the University of Wisconsin by Starch, in which eight subjects were drilled for 14 days on mental multiplications and in which their efficiency in subsequent tests of various arithmetical operations and in memory span for words was compared with that of an unpractised control group. There was 'little change for memory span for either group,' but 'the practised observers showed from 20 to 40 percent more improvement in the arithmetical tests than the unpractised observers.' * In weighing the significance of this large transfer-effect, however, we should note that the abilities demanded in the test series were closely similar, if not at times almost identical, with those demanded in the drill series.

"(d) Wallin. Another school subject, that of spelling, was the material chosen by Wallin for a study of transfer of efficiency gained in 'column drills' to performance in dictated

* Starch, D., *Journal of Educational Psychology*, Vol. II, pp. 306–310.

compositions. This investigation was made on more than a thousand pupils of the public schools of Cleveland. Some three to thirteen weeks after several weeks of drill in column spelling, the pupils were graded on their spelling of 40 to 50 words employed by their teachers in dictation. Wallin concludes that the column drill may produce a positive increment of spelling efficiency, an increased facility to master new forms. Despite the large number of pupils employed in this study, the experimental conditions were not ideal to yield clear-cut evidence of transfer (there was, for instance, a certain amount of incidental teaching of spelling).

"(e) Briggs. Decidedly complicated is the contribution of Briggs, who employed two groups of 7th-grade children for an investigation of the effects of formal instruction in English grammar. An extended series of 54 problems and exercises constituted the preliminary and final test series and the intervening drill was in grammar taught somewhat inductively. Supplementary trials of the tests were made in five public school systems, some of which taught grammar and some of which did not. Taking the average performance of the classes under test, the net outcome is negative, i. e., to quote Briggs: 'It may safely be asserted that these particular children, after the amount of formal grammar they had, do not, as measured by the means employed, show in any of the abilities tested, improvement that may be attributed to their training in formal grammar.' *

"(f) Hewins. The monograph by Miss Hewins deals with a more mature group of pupils (high-school freshmen) and with a different mental function (training in observation). After dividing the pupils of several classes into equivalent groups on the basis of suitable preliminary tests, one group in each class was drilled on the observation of biological material. Final tests were given to the entire class on the observation of non-biological material. On the whole, the results justify the assertion that 'there are certainly conclusive evidences of transfer.' †

"(g) Rugg. Omitting detailed reference to Bennett's attempt by studying college marks and scores in laboratory tests to show that the four years of college work are effective only in

* Briggs, *Teachers College Record*, Vol. XIV, p. 41.

† Hewins, Nellie P., "The Doctrine of Formal Discipline in the Light of Experimental Investigation," Warwick & York Incorporated (1916).

increasing specific abilities along the lines of special interests, we may cite the work of Rugg as perhaps the most comprehensive study of the transfer of training among college students. Five hundred University of Illinois students were tested, of whom 326, the training group, pursued a course in descriptive geometry. The aim of the investigation was to determine the extent to which the special training received in this course operated to increase efficiency in various other mental activities of different degrees of similarity to the activities trained. The results show that the practice in geometric visualization received in the 15 weeks' work in descriptive geometry did substantially increase the efficiency of 'mental manipulation' of both geometric and non-geometric elements, and that the degree of transfer, as would be expected, varied with the degree of similarity between the practice and the test activity. As for the agencies of transfer, these were found by Rugg to lie not only in the direct carrying over of specific habits, but also in better methods of attack, better attitudes of orientation, and an increased facility in manipulating many elements at the same time.

"(h) Thorndike. One of the most ambitious recent studies of transfer effect in the school is that reported by Thorndike, who used statistical methods applied to intelligence test scores to determine the effect of a year's school work in various high-school subjects upon the amount of the traits measured by these test scores. The essentially negligible disciplinary effect thus unearthed may perhaps be set forth most effectively by the following quotation:

" 'If our inquiry had been carried out by a psychologist from Mars, who knew nothing of theories of mental discipline, and simply tried to answer the question "What are the amounts of influence of sex, race, age, amount of ability, and studies taken, upon the gain made during the year in power to think, or intellect, or whatever our stock intelligence tests measure," he might even dismiss "studies taken" with the comment: "The differences are so small and the unreliabilities are relatively so large that this factor seems unimportant." The one causal factor which he would be sure was at work would be the intellect already existent. Those who have the most to begin with gain the most during the year. Whatever studies they take will seem to produce large gains in intellect.'

"Special mention may be made also of the conclusion that the physical sciences are equal, if not superior, to languages and mathematics in respect of mental discipline from any point of view.

"*What Has Been Proved Concerning the Amount of Transfer.* While by no means exhaustive, the foregoing description of typical investigations has been sufficient to indicate the characteristic methods by which the problem of transfer has been attacked experimentally. But the outcomes of these investigations are so varied that some attempt should be made to summarize their general trend. This I shall attempt by setting down a series of categorical statements.

"1. In the light of what we now know to be necessary for reliable inference, many of the experimental studies of transfer are so inadequate in scope and method that they afford altogether too shaky ground for establishing permanent conclusions.

"Thus, the subjects have been too few in number or already too well 'crystallized' mentally to expect any marked transfer of improvement. The material upon which the training has been accomplished has often been, I think, too 'picayunish' to exert any natural appeal. Again, there has been often no control group or there has been no effort to compute statistically the extent to which mere chance has affected the result. Yet again, the training has been too brief to promise any far-reaching or significant alteration of the mental efficiency of the recipient. Finally, many of the investigations have picked for their subjects a half-dozen graduate students or instructors, who, in the very nature of the case, represent a type of mind that has been rigorously selected for having already attained a superior stage of mental training. No doubt these objections may be exaggerated, but personally, I cannot avoid the conclusion that a considerable part of the experimental work on the transfer of training might as well be thrown out of the window bodily so far as any significant contribution may be expected to our knowledge of the real possibilities and limitations of training.

"2. There can be counted on the fingers of one hand the experimental studies that have definitely yielded the verdict: 'No transfer.'

"Here might be placed, for instance, the pioneer experiment

of James, the neatness experiment of Mrs. Squire, the correlation study of Bennett, and the formal grammar study of Briggs. Some of the studies that have been quoted as supporting this position, like my own study of visual apprehension, are not properly classed as studies of transfer. They have merely shown certain essential limitations in the nature of the practice improvement that occurs in adults when faced with the acquisition of a new set of responses. Thus, to deny that practice in rapid observation improves any intrinsic capacity or faculty of observation itself is not to deny the possibility of the transfer of training. It is unfortunate that this interpretation has gained such currency among certain popularizers of the experimental literature.

"3. Several studies in which the investigator has claimed a large or a very definite amount of transfer provide inadequate proof of this claim or deal with a type of transfer in which the shift from trained to untrained activity is so slight as to be of little practical significance.

"In making the assertion of 'inadequate proof,' I have in mind the investigations of Ebert and Meumann and of Coover and Angell. In making the assertion of 'no practical significance' I have in mind the so-called 'transfer of training' in the reaction-time tests of Gilbert and Fracker or Wallin's 'other eye' transfer or Wallin's transfer from spelling in a column to spelling in a sentence. To exaggerate to the point of grotesqueness, of what avail to demonstrate that having trained myself to sing a song while wearing a hat, I find I have improved in singing it with my hat off?

"4. In a preponderant number of investigations there has been revealed a measurable, though restricted amount of transfer. In general, the more similar the influencing and the influenced activities, the more certain the transfer of efficiency and the greater its amount.

"Anyone who reads the literature of formal discipline in chronological order will perceive clearly that investigators have been swayed at times by their own attitude toward the popular notions of transfer prevalent when their investigations were conceived. The effect of this attitude is not infrequently revealed in the manner in which the investigator has formulated his conclusions. If he thinks there is current a naïve belief in general

cultural training, in widespread transfer, then a definite, though moderate amount of transfer in his experiments is set forth as a demonstration of the specificity of training and the futility of belief in formal discipline, although it might quite as well have been heralded as a partial justification of the dogma.

"5. The transfer of training may impair the second activity, rather than improve it. It appears likely that this so-called 'negative' transfer is most pronounced when the second activity is begun and that it may not only be reduced to zero, but become transformed into a positive transfer if the second activity is continued long enough.

"This outcome is perhaps sufficiently perplexing at first view to warrant a simple illustration. A man well trained in operating a standard automobile gear-shift, when suddenly called upon to operate a car with reversed shift (like the Dodge, for instance), might, on account of interference, perform the shifting at first less efficiently than a novice; if he persisted, however, he would eventually surpass the novice, because he would already have learned the underlying general principles of correct gear-shifting and these would be 'carried over' advantageously, once the specific differences between the two cars were overcome."

[Whipple, Guy M., "The Transfer of Training," in *Twenty-seven Yearbook*, National Society for the Study of Education (Public School Publishing Company, Bloomington, Illinois, 1928), Part II, "Nature and Nurture: Their Influence upon Achievement," pp. 186–200.]

The problem of transfer of training is sometimes raised in the form: Are habits wholly specific responses to specific situations or are there habits that are generalized? The analysis made by the author of the selection which follows is an especially valuable one in showing that habits are neither wholly specific nor wholly generalized. The students should not overlook the part that the author attributes to attention as a factor in the generalization of experience.

3. FORMAL DISCIPLINE AND GENERAL PSYCHOLOGY

Three Kinds of Habit. "We may roughly divide our habitual reactions into three groups, groups which are frankly arbitrary, but which will reasonably serve the practical purposes of our

present business. There is (1) the sort of thing to which the term is most often applied and to which the characterizations of a few moments ago are most germane: i. e., motor activities in which the significant feature is some change brought about by the movement in the physical world. Walking, running, talking, and writing may illustrate this group. Here the important thing is the overt external result of the act; the distance traversed, the word spoken or written, and so on. Next (2) may be mentioned habitual acts in which the purport of the act is to be found not in the mere external result, but in some sensation which the act facilitates, emphasizes, or renders possible. Here belong the habitual accommodatory movements by which we focalize our sense organs on stimuli to which we wish to attend. I turn my head to see an interesting object. I turn in quite a different manner to hear the indistinct speaker. I give it still another shift, accompanied by certain accessory inspiratory movements, if I wish to get the full fragrance of a bunch of violets, etc. All these sensory activities involve motor accommodations of the habit variety: i. e. efficient muscular acts involving at present little or no conscious guidance. (3) Lastly there are certain ideational processes to which psychologists are sometimes hesitant to apply the term habit, because of the apparent absence of motor elements in some of them, but which certainly deserve it. The boy learning to use the multiplication table illustrates the point. As he becomes more and more expert, his mind executes arithmetical operations more and more automatically, until finally perhaps, here as elsewhere, the activity becomes essentially reflex.

"The term 'habit of thought' is applied to other forms of intellectual procedure with the intent sometimes to designate certain sentiments and prejudices, or again, to indicate that which is more nearly relevant to the present discussion: i. e., one's general methods of attacking a subject, the technique of one's thinking. The intellectual method which one acquires after a certain period of discipline in any field of thought—e. g., history, literature, economics, or commerce—will illustrate the case. One gets into a manner of dealing with such problems and bringing certain considerations to bear upon them which essentially merits the term habit, although the operation may be considerably less mechanical and inflexible than is the case in

the ordinary overt motor types of habits. Individual A always hunts for the details of his problem. Individual B has no interest in details, but always seeks at once the general bearings of the case. Individual C invariably lays out a systematic plan of campaign and follows it to the bitter end. Individual D dips in anywhere and continues to dip without reference to any scheme of action. These illustrations may serve to make clear the point. Now on the basis of this cursory examination of certain typical manifestations of habit, let us consider the probabilities as regards the effects of general training, or the carrying over of facility from one sort of habit to another."

Incorporation of Smaller Habits into Larger Habit Groups. "One kind of process which certainly goes on all the time and which may have a remote bearing on the general point at issue, is the incorporation of smaller habits in larger habit groups. The child in learning to write has at first to give all his energy to the mere grasping and guiding of the pen. As dexterity is gained, the movement comes to take care of itself and gets incorporated in another and larger coördination: i. e., the spelling-and-writing coördination. This in turn gets taken up into a 'paragraph-construction habit,' which in its own turn may be swallowed up by the chapter, article, or section habit. Not that this account necessarily follows any unchanging chronological sequence or is true of all persons, but that it illustrates what is generally true all along the line: i. e., that specific habits are constantly merged with other specific habits to furnish forth larger and more complex coördinations. This is true of each of the three forms of habit which we have distinguished, and illustrations will readily suggest themselves. Evidently it might well often occur that a habit acquired in some special study should find a place in a larger group of habits apparently quite disconnected from the study. This is peculiarly true, it may be added, of all the common studies of the elementary school."

Facilitation and Opposition of Habits. "It seems clear, too, that habits closely akin to one another may readily reinforce each other in a practical way, even though the literal fact should prove to be that one or other is slightly modified in this case, rather than merely reinforced. For instance, a boy who has learned to play baseball and to judge accurately the position of a ball in the air, has a large part of the difficulty of certain

strokes in tennis already conquered, despite the fact that the position which he must assume to meet the ball in the two cases is somewhat different. Here again we should on examination find that all our classes of habit would furnish illustrations of the principle.

"On the other hand, certain habits are apparently inimical to certain others. In a general way we recognize this when we lay stress on the avoidance of contracting 'bad habits' at the outset of any new undertaking. Such habits may be bad in the conventional moral sense, or merely in the technical sense that they limit efficiency. But in either case we feel such habits to be not only inherently undesirable, but also a menace to the opposed good habits and an added difficulty in the securing of the latter. Apart, however, entirely from the question of bad habits, so-called, there seems to be no doubt that certain habits, if they become thoroughly ingrained, may go far to incapacitate their possessor from contracting in an effective way certain other kinds of habits. One who has learned to drive spikes with a sledge hammer will probably find it more difficult to learn to execute fine embroidery than would have been the case had he not received the sledge practice and contracted the sledge habit. Similarly, one who has learned to concentrate altogether on the meaning of the printed page, and especially one who has learned to combine this capacity with great rapidity of reading, finds it extremely difficult, if not impossible, to read proof accurately. And conversely, it may be doubted if any first-class proofreader ever succeeds in reading very rapidly and at the same time with understanding. Attention has to be differently directed to achieve the two ends.

"That our tastes and capacities rapidly become limited to those which we choose to cultivate is of course a fact familiar in literature as well as in common life; but as this fact has a possible explanation somewhat irrelevant to our topic, we may pass it by without further comment.

"In academic life what is so common as to observe that men who have confined themselves assiduously to one field of intellectual endeavor become largely incapable of entering into other fields of interest? It is not simply that their tastes rebel at the attempt. The machinery of their minds has lost a certain flexibility which possibly was once possessed. All of which seems to

show that expertness in specific directions instead of carrying with it unmitigated blessings may be purchased at a very great price, the price of efficiency in other important directions. It must be frankly confessed, however, that such instances are always ambiguous in the form in which we meet them in ordinary experience, because we have no reliable means of determining how far the outcome is due to native limitation of talent, or to the accidents of environment, and how much is justly attributable to the sheer undiluted effects of the special form of intellectual discipline pursued."

Generalized Habits. "This brings us fairly to the question whether there are any generalized habits. Or, are all habits essentially specific? In the habits by which we accommodate our sense organs to things to which we wish to attend, the process is apparently highly specific, and any gain in the efficiency with which we use one sense organ, say the eye, resulting from the use of another, say the ear, must spring from some central factor common to the use of the two, of which no mention has as yet been made. To this hypothetical factor we shall refer again in a moment. Similarly, the habits which consist in effective manipulations of external objects have for the most part a highly specific character. One who has learned to hammer skillfully can drive nails or tacks with equal deftness perhaps, but sawing requires a quite different set of coördinations, and planing still another. Whether such habits will, on the whole, reinforce or inhibit one another can only be determined by actual test. In the intellectual range of habits we meet the most complicated case, and this brings us to the part played by attention and ideal control in all these cases. Personally I am disposed to believe that the most important elements in the whole situation before us are capable of statement in terms of attention."

Attention as Means of Transfer. "Leaving aside for the present purposes all more subtle meanings, I shall intend by the word 'attention' the fact of mental concentration. We may accept for our present practical interests a common psychological distinction between sensory and ideational attention. In the one case, the mind is concentrated on some sense process; in the other, on some idea or train of ideas. Evidently there will be at least as many subordinate forms of sensory attention as there

are sense organs. As we remarked a few lines above, when we attend to a sound our attitude is quite different from that which we assume when attending to a light, and both differ from the attitude of attention to an odor. There is mental concentration in each case, and yet the acts are in the main quite distinct from one another. Similarly, in instances of ideational attention, despite the common characteristic of concentration, there will be some difference in the process as a whole, depending on whether we are calling into mind memory images of sound, or of things seen, or are reasoning out some algebraic abstruseness which may chance to be teasing the mind.

"Now so far as these several forms of attention have divergent elements in them, and certainly there are many such divergences both of sensory content and of motor attitude, we shall hardly be entitled to look for beneficial effects in the use of one form of attention as a result of discipline in another form of it. So far as the two activities are different, it is difficult to see why a training in tone discrimination should produce a beneficial effect upon the discrimination of shades of color. But if we look more closely at the facts we shall see that there are certain factors common to all these cases which have not been mentioned.

"The persistent and voluntary directed use of attention, especially when the subject attended is lacking in interest, speedily becomes acutely distasteful. Voluntary attention involves some strain, and this strain, if long continued, is certain to become unpleasant. We first become bored, then restless, and finally find the thing intolerable and abandon it. Now no small part of the discipline which comes from the effortful use of attention in any direction and on any topic is to be found in the habituation which is afforded in neglecting or otherwise suppressing unpleasant or distracting sensations. We learn to 'stand it,' in short. This fact has been pointed out at times by writers on these topics, but it is rarely given the importance which it properly deserves. Any one can attend to things which interest or please him as long as his physical strength holds out. But to attend in the face of difficulties which are not entertaining is distinctly an acquired taste, one to which children and primitive peoples always strenuously object. From this point of view it may well be that such studies as the classics and cer-

tain forms of mathematics have a peculiar value in affording the maximum of unpleasantness diluted with a minimum of native interest, so that a student who learns to tolerate prolonged attending to their intricacies may find almost any other undertaking by contrast easy and grateful. The actual mental mechanism by which this intellectual and moral acclimatization is secured, is extremely interesting, but we can not pause to discuss it. Certain it is that something of the sort occurs and that it is an acquirement which may presumably be carried over from one type of occupation to another. If each form of effortful occupation had a wholly unique type of discomfort attached to it, this inference might be challenged. But such does not seem to be the case.

"Again it is held by certain psychologists that, although each form of sensory and ideational attention involves a special and peculiar motor attitude not found in any other form in which attention may be exercised, it is nevertheless true that there is a general attitude on which each of these special forms is grafted which remains as a constant background for all. Of course if this contention be true, and I am disposed both on theoretical and on experimental grounds to think that it is, there would be some matrix common to all acts of attention, and any development whatever would affect this central core in some degree."

[Angell, J. R., "Doctrine of Formal Discipline in the Light of the Principles of General Psychology," *Educational Review*, Vol. XXXVI (1908), pp. 4–10. By permission.]

Professor Judd has been one of the most strenuous opponents of the doctrine that training is wholly specific, and in contending that valuable educational results are lost unless the aim of teaching takes into account the necessity of cultivating attitudes that function generally. After reviewing some of the experimental literature Professor Judd proceeds as follows.

4. THE RELATION OF SPECIAL TRAINING TO GENERAL INTELLIGENCE

Training in Observation. "A boy is taught to look for birds. Does he become more alert in looking for flowers and rocks? That depends entirely upon what looking for birds means in the case under consideration. If a boy is taught in a narrow way to

name birds and to look for their nests, with no intimation that there is anything else in the world of nature for which to look, then it is not probable that he will tend to generalize his attitude toward the world sufficiently to include other observable facts. If, on the other hand, a boy is taught to open his eyes to all the facts of the world; if, for example, he is taught that swimming birds have certain characteristics, running birds other, and that certain birds will be found in one kind of an environment, other types in other surroundings, then the tendency to generalize observation will be strong. It is safe to say that looking for birds may be a narrow training in some cases, and a very broad training in others. The most important educational principle here involved is not a principle of special mental functions, but the principle that good teaching aims at generalizations."

Arithmetic and Algebra. "Again, if we ask whether arithmetic is helpful as an introduction to algebra, the answer depends upon what we mean by arithmetic. One of the most vivid educational lessons I ever learned came to me when I once undertook to help some candidates for teachers' certificates review arithmetic. I gave them examples, and the question they always asked me was which rule in the book the example belonged under. Those girls had a kind of arithmetic which would not carry the weight of any algebraical superstructure. On the other hand, I have seen arithmetic taught as a method of comparing quantities in such a way that the transition to algebra could not be felt as anything but a legitimate function."

Developing Implications. "There is another way in which I shall venture to put this matter of the desirability of generalizing training. A teacher who has a broad outlook on any field of knowledge will make a single piece of information carry to the student not only a bare kernel of truth, but a whole network of suggestions by which the central truth connects with the rest of the world. Suppose I say to a boy, Cæsar was a great general. That is doubtless true, but it is a kind of nugget washed up in its separate purity and carried away by a boy with very little suggestion of other possibilities of rich findings. Now let me say instead that Cæsar was a great man who, living in a military age, achieved his greatest success as a military leader. I think we have an idea which leads into a whole mine of truth.

"It will be noted that in this simple illustration I have tried to make it clear that the teacher is not called upon to say to the pupil, this idea has implications. The idea ought to be given with its implications present and actively reaching out into the world of new experiences. To check the legitimate flow of association in order to contemplate the process of association is a mistake. The skilful teacher keeps ideas moving without calling attention to the machinery.

"The qualification which more than any other fits a teacher to present ideas with their implications, is the qualification which prepares a teacher to look all around a fact. The teacher ought to see what a fact is going to be used for later. The child has no perspective; the teacher should have. The teacher whose ideas are broad can do much to prepare the student to see and cultivate universals. The teacher who is narrow through little training can do much to close the mind of a pupil to the possibility of transferring his culture to anything else. The teacher who knows nothing beyond what he teaches can only by the rarest good chance make a remark which will open the mind of his pupil to new connections. The teacher who is full of the legitimate developments of the ideas which he is teaching will never limit his students to a narrow formal view of facts."

Function of Reviews. "There are a few very specific suggestions which seem to me to grow out of the position which I have attempted to defend before you. Most of our textbooks are written with a division and subdivision of the subject and a finished nicety of definition which destroys all possible links with anything else. Knowledge must, I am clear, be divided into fine particles in order to pass the narrow gateway into the young mind, but I never take up one of these highly dogmatic and completely subdivided textbooks on grammar or arithmetic without a shudder. The formal divisions dominate us in our teaching to such an extent that I have sometimes thought that the statistics of the non-correlationists are the artifacts of our educational system. Our textbooks make boys and girl learn in such a way that there shall be a wall of division between arithmetic and everything else. And not only so, but we make the intelligent child, who would naturally find common characteristics in the various processes which are described within the covers of a single book, afraid to look from one section into the

next. I suppose you are asking what can be done about it. This much can be done, if nothing more. We can have reviews in our schools designed for the specific purpose of correlating and generalizing knowledge. If we need to divide knowledge into fine parts the first time it is presented, let us recognize with all clearness that in reviews we should not devote ourselves to going over the fine subdivisions, but we should rather develop the general phases of experience. There is a general phase in every experience. To get at it is worth much time and effort. If you bring it out, the particular facts all fall into their proper relations and the compact whole is a substantial structure, not a mass of raw, detached materials. When teachers come to realize the value of reviews, I believe our textbooks will also take on a different form. There will still be divisions, but they will not be so formidable or so disintegrating.

"The second observation which I wish to make is this. It has been my experience that school work drifts to the precise and exactly markable answer and corresponding question. It is so easy to ask a good question in rhetoric and so hard to ask a good question in literature. It is relatively easy to have a show recitation in Latin made up of definite questions and answers which can be evaluated with mathematical precision. It is relatively hard to make children describe some of the commonplace facts of the world of nature. As a result we drift into the exact forms of teaching. We say Latin is invaluable because it is so precise. I think we ought to ask whether it is capable of cultivating powers of generalization. We say that scientific studies have not been formulated for teaching. For my part, I find this one of the richest fields for educational genius because it has not been trampled into lifeless atoms by the weary tread of generations. One living, palpitating truth, grasped even vaguely, seems to me better than many isolated gems of formalism. If our supervisors and teachers could be freed from the bane of precise evaluation and could apprehend the significance of truths which have broad implications, our education would, I firmly believe, make inestimably greater progress."

Educational Dogmatism. "Finally, I wish to make in this connection a plea for less dogmatism in educational theory. The one thing I have tried to make clear in this paper is that a dogmatic answer to the question of transfer of training is totally

impossible. Does nature-study train in observation? Does washing of slates train in neatness? Does saying good-morning to the principal conduce to good manners on the playground? If there is any dogmatic answer given you when you ask these questions, put it aside. There is no single answer to any one of these questions. Teachers have become so fixed in their habits of using precise textbooks and asking precise questions and accepting precise answers that they want precise pedagogical formulas. This is itself a very good illustration of generalization of a bad habit of mind. There is another and juster attitude toward educational problems. Every educational situation is a new situation and is full of possibilities. Will one experience effect others favorably or unfavorably? The answer is, the effect of one experience on later life depends on the character of that experience and the way it is managed. We may make of our pupils eager seekers after truth, or we may make of them bigoted little dogmatists. What we do will depend very much upon what we and our interests are. If we believe in specialized functions we shall probably do very little to generalize knowledge in our students. If, on the other hand, we have broad views of the subject we are teaching and of our task in teaching it, we shall find very little in practical experience to bind us to the narrow view that mental life is made up of watertight compartments."

[Judd, Charles H., *The Relation of Special Training to General Intelligence,* "Educational Review," Vol. XXXVI (1908), pp. 28–42. By permission.]

QUESTIONS

1. State the two opposed views of the nature of mind which concern the doctrine of formal training.
2. Explain the statement: You train what you don't train.
3. Show the need of training in special knowledge and habits.
4. Discuss the rôle of emotions in relation to transfer of training.
5. State some of the ways which Stratton recommends as means for obtaining both specific and general values from training.
6. Summarize Whipple's interpretation of the evidence obtained from experiments on transfer of training.
7. Describe three types of habits.
8. Discuss "attention" in relation to transfer of training.
9. Does training in observation of birds increase the general capacity to observe?
10. Summarize the views of Judd concerning the most important means of broadening school experiences so as to get the greatest values from training.

Wed. Chapt. X in Lundiford.
Thurs. XI "
Friday. XII "

CHAPTER XIV

READING

Perhaps the most significant result of the investigations of the nature of reading has been the recognition of the principle that reading is not a mere response to sensory impressions but is, above all, an acquisition of meanings. This excerpt from O'Brien's *Reading: Its Psychology and Pedagogy* states the position held by many psychologists in regard to the psychology of meaning and its educational significance.

1. THE PSYCHOLOGY OF MEANINGS

"While experimental research into the number and length of eye movements, the duration of the fixation pause, and the general motor behavior of the eyes has cast a helpful light upon the reading act, it is needless to say that the fundamental and crucial processes are the intangible ones which lie back of the eye-movements and fixations. How are the perceived visual symbols interpreted by the mind? How do meanings arise after the ocular adjustments have been completed?

"The psychology of a generation ago had a very simple, naïve explanation. The mind was conceived as a storehouse of images or pictures of objects and occurrences in the outside world. The sight of the word simply aroused the visual images or picture of the object or event and the meaning was thereby secured."

Meanings and Reactions. "Careful investigation has cast the old traditional explanation into the discard, by demonstrating the frequent absence of visual imagery in the reading of many persons, and their grasping of the meaning of the passage without the intercessory aid of pictorial imagery. Instead of viewing the mind as a mere storehouse of memory images, modern psychology sees it as a dynamic, organized personality reacting to the stimuli of the external world. The essential element in the interpretation of a word is, therefore, the phase of the individual's experience

connected therewith, or his associative reactions. This fact is thus illustrated by Judd: 'When I see food I do not merely receive in the mind an impression or call up memory images; I am aroused to a form of vivid desire and of vigorous reaction. My experience corresponds to the tendencies toward reaction which are aroused in me more than to the image which I have in mind. Indeed, I may not look at the food in a way to see it in very great detail; I may be vague about what it is that appeals to my hunger, and yet I may have a very vivid consciousness of desire corresponding to the fact that I eagerly reach for food. Thus with many of our experiences, especially those which have to do with our most urgent and fundamental needs, there is little emphasis on the picture in the mind and great emphasis on our reactions.' *

"The reactions to the stimuli of the external world in the form of objects or events are gradually carried over to the words themselves, so that the perception of the words immediately arouses the corresponding reactions. Most persons experience a recoil reaction from a snake. This same type of reaction becomes associated with the word 'snake' so that the perception of the word immediately sets off the nascent recoil reaction without the intercessory agency of a visual image. This statement is further corroborated by the use of figures of speech which are means of carrying over attitudes rather than pictorial images. Thus, as Judd observes, the individual who expresses himself as having undergone a bitter experience really means that he has gone through the same disagreeable recoil which he feels when there is a bitter taste in his mouth. In this case 'bitter' refers not to the taste, but to the attitude caused by the aroused nascent reactions.

"*The Function of Pictures.* The particular function which pictures perform when used to assist the beginner to attach meaning to the words is apt to be misunderstood. A teacher may hold up a picture of an apple before her pupils, and write the word 'apple' on the blackboard before them. The ordinary conception of the purpose of this action is that it serves to stamp a vivid pictorial image upon the mind. But whether the teacher knows it or not, the psychological process which really occurs is substantially this: The picture of the apple arouses the interest, reactions and experiences which the pupil has thus far had with apples. The

* Judd, C. H., "Reading Its Nature and Development," Suppl. Ed. Mon., Vol. II, No. 4, July, 1918. University of Chicago Press.

writing of the word on the board at the same time serves to carry over to it all the awakened experiences and vivid reactions of the pupil, who has handled, tasted, chewed and played with apples at various previous times. The word 'apple' has thus become a dynamic symbol charged with vital interest, and clothed with interpretative experience. It is only because pictures serve to arouse vivid interest, personal reactions, and carry this awakened experience over to the words themselves that they are of assistance to the beginner in learning to read.

"On the psychology of interpretation, perhaps no one has written with greater penetration than Judd, who says: 'Whether the teacher uses the picture or the spoken word, the real purpose of the exercise is to attach to the printed word an interpreting attitude. The more vivid the experience used, the more vivid will be the reaction and the more complex the interpretation attached to the printed word. It is well, therefore, that a teacher should use pictures and objects, but in trying to understand what goes on in the pupil's experience the teacher should understand that the concrete object is in itself a subject of interpretation through the reactions which attach to it."

Materials for Reading. "From this analysis of the psychological processes of interpreting printed symbols there flow two corollaries of practical pedagogical importance. First, since reading in the primary grades is not so much a matter of extracting meaning from the printed symbols as it is of attaching meaning to them, it follows that the content of the primary readers should be well within the pale of the child's experience. Otherwise there will be lacking the aroused nascent reactions which are necessary to accompany the printed words to give them meaning. Where this associative experience is lacking, the only response which results is the mechanical reaction of the articulatory muscles. The printed word still remains barren, meaningless, unclothed with personal interest or the associative experience necessary to give it meaning. Where much of the material in primary readers is of this unfamiliar type, beyond the reach of the child's interest and experience, there results that dull, mechanical, parrot-like kind of reading which might better be termed empty vocalization. Horace Mann amply described it as 'a barren action of the organs of speech on the atmosphere' instead of 'an exercise of the mind in thinking and feeling.'

"In the report of Horace Mann to the board of education of Massachusetts in 1838, made after a careful and extensive investigation of the reading of the grade school pupils, he penned the following indictment of the then prevalent teaching of reading. The result of the formal mechanical reading at that time in vogue was 'that more than eleven-twelfths of all the children in the reading-classes, in our schools, do not understand the meaning of the words they read; that they do not master the sense of the reading-lessons and that the idea and feelings intended by the author to be conveyed to, and excited in, the reader's mind, still rest in the author's intention, never having yet reached the place of their destination. And by this it is not meant that the scholars do not obtain such a full comprehension of the subject of the reading lessons, its various relations and bearings, as a scientific or erudite reader would do, but that they do not acquire a reasonable and practical understanding of them. It would hardly seem that the combined efforts of all persons engaged could have accomplished more in defeating the true objects of reading.'

"The light cast upon the nature of the reading act by the huge volume of painstaking psychological research, both of the introspective and of the laboratory type, since the days of Horace Mann has disclosed more clearly the various psychophysical steps in the reading process, and has resulted in a conspicuous refinement of the technique in the teaching of reading, but that the kind of meaningless mechanical reading so prevalent in the days of Horace Mann, and so strongly condemned by him, has by no means completely disappeared from our present-day class-rooms, the experience of teachers and supervisors of reading will abundantly testify. . . .

"The second corollary of practical pedagogical consequence flowing from the psychological analysis of the interpretation of printed symbols is this: Those words which awaken not only the child's experience, but which arouse also his deep, personal, vivid interest will be found to be the easiest to interpret. While interest is not the same indispensable requisite for interpretation that experience is, it is the element which renders the interpretation easy, pleasant and rapid. Dull, uninteresting objects in the child's environment may be used in teaching the pupil to read, but the slowness and the effort required is in marked contrast with the rapidity and the facility of the reading when the story appeals

strongly to the spontaneous interests of the child. The more deeply and vividly the material is surcharged with interest, the more strongly will the personal reactions be aroused and the richer will be the experience necessary for the interpretation of the printed symbols. That is why recent primary books display a wise preference not only for the concrete but for those elements within the concrete which are rich in vital, vivid, dynamic interests, and thereby enlist the spontaneous interest of the child's mind in gaining the mastery of the printed page. That is also why the older primary readers with their lessons about such disconnected objects as man, fan, cat, ball, house, wall, etc., completely lacking in story plot, are yielding before the newer type of readers whose material is built into story plots and is rich in dramatic values for the child."

[O'Brien, J. A., *Reading: Its Psychology and Pedagogy* (The Century Co., New York, 1926), pp. 41–48. By permission.]

One of the sources of the inefficiency so frequently found among students is the inability to read rapidly enough to cover the ground of their assignments in a reasonable length of time. The fact is that many students have not learned to read in any real sense, especially to read silently. Like practically every other ability, reading may be increased in speed without loss of ability to interpret the meaning, if the student is willing to persist in practice.

2. IMPROVEMENT IN RAPID SILENT READING POSSIBLE

Improvement Possible. "Experiments have shown that with a moderate amount of practice speed in reading may be increased from 50 to 100 per cent, if one's attention is directed sharply enough toward this particular point. It has also been found that forcing oneself to read more rapidly does not necessarily decrease one's power of comprehension. In fact, rapid reading naturally results in greater concentration of attention on the work; this makes the comprehension of what is read greater than when one reads it at a slower pace. In rapid reading one is forced not only to attend more closely to the work taken as a whole but to look for the more important sentences and words. This soon enables one to comprehend better what he reads than could be done if he read

more slowly. It has been shown that increasing one's rate of reading is regularly accompanied by increased ability to get the thought. You should, therefore, force yourself to learn to read as rapidly as possible.

"*How Improvement in Rapid Reading May Be Made.* It has been found that most college and high-school students read only about as fast as they can pronounce the words orally, and that they read more slowly than they did when they were in the elementary grades. It is also well known that rapid reading is required to succeed with our work and that all college and high-school students could very easily improve their rate of reading from 50 to 100 per cent.

"In order to bring about this type of improvement a student must first of all really want to improve in his rate of reading. He must feel that it is valuable or necessary for him to do so, then direct his efforts and attention sharply to speeding up this particular phase of his work."

Filling in the Thought. "To do this it is best to practise with materials where the context is well known and where the topics discussed are clearly set forth in the paragraph and sectional headings. This makes it easy to hold these topics in mind as you read. To read rapidly and by sight as contrasted with the verbal method of reading you must learn to fill in the thought from two or three salient words in each line or sentence. Without taking a second glance you must press on, trusting that later sentences in the paragraph will clear up the meanings that you do not instantly catch. In general, it is helpful to notice the first and last words of the key sentences. But you must also look for the key sentences in each paragraph and for the most important paragraphs in each section or chapter.

"If you merely want to follow the author's argument from the beginning to the end of the chapter, you should read by paragraphs rather than by sentences. The subject of a paragraph is usually contained in the first sentence or two. The other sentences merely explain this topic or thought sentence. The last sentence of the paragraph is important because it usually contains a summary of the thought explained in the paragraph. To get a correct idea of what your author is discussing you should therefore glance at the first short sentence or two in each paragraph. If this is sufficient, you may skip the rest of the paragraph and go to the

next. If the first few sentences do not develop enough of the thought to carry you on, glance at the last sentence. At times, of course, you should pause to develop the thought further by reading the intervening sentences.

"If you want to see what the book as a whole has to contribute to the particular problem that you are investigating you will be able to do it quickly and rather accurately by noting carefully the subject of each chapter and section and by reading the first paragraph or two and the last paragraph of each chapter. The sections that discuss the particular topics in which you are interested should of course be marked and read in more detail, and particular attention should be given to the key sentences in the paragraphs dealing with those topics. By the use of this method G. Stanley Hall could examine two wheelbarrowfuls of books in one afternoon and night and get from them all the new facts they contained on the subject on which he was lecturing at eleven o'clock the next day.

"The secret of learning to read rapidly is, therefore, the learner's desire or deeply felt need for greater efficiency in this direction, learning to slide over unimportant words or sentences, emphasizing the key words in a sentence and the important sentences in each paragraph, but never giving them so much time that they can or will be inwardly pronounced. These sentences usually contain the topic discussed, while the last sentence or two in the paragraph sums up what has been said or concluded on this point. This process is generally repeated in the chapter or other large units of the text: the subject of such a chapter or division of the book is usually named and developed in the first few paragraphs, while the last paragraphs in the division contain a brief summary of what has been said earlier on this topic. The index, table of contents, and preface of every book studied should of course be consulted at the start to determine what it is about and to see how the various problems discussed are treated by the author.

"In getting the thought from a text, a student must do the same sort of thing that a pianist does in playing a score of music from sight. He must learn to neglect all the easy and well-known points, all the words that can be readily filled in by the mind when the key words are noted and recognized. Like the musician, the reader guesses at these connections and fills them in correctly because of the higher language habits that he has already acquired.

This is possible because the reader is attending to the essential thoughts or sentences which carry him along. Learning to read rapidly and yet effectively consists mainly in being able to select these important sentences and words and to neglect the unimportant ones which the reader fills in mentally from the dominant sentences and words that he clearly apprehends.

"One of the best aids to the acquisition of this kind of skill is to make it a practice to see how many pages of a given text you can read correctly in five minutes, checking up on the efficiency of your reading after each trial by writing down immediately after the reading what you have read during the test. By keeping an accurate record of the amount and accuracy of what you are able to read in such a test you will finally force yourself to read both more rapidly and effectively and so increase your skill until your physiological and mental limit for this type of work has been reached."

[Book, W. F., *Learning How to Study and Work Effectively* (Ginn and Company, Boston, 1926), pp. 352–355. By permission.]

Judd and Buswell have made an extensive investigation of reading habits as they appear in students of various ages and in connection with the reading of various kinds of materials. Among other methods of analysis they used the method of eye-photography to determine what goes on when students of various degrees of maturity are reading algebra, French, Latin, etc., as well as English for various purposes. Some of their conclusions follow.

3. TYPES OF SILENT READING

Primary Reading Habits Must Be Discarded. "Teachers have known for a long time that the process of reading fluently to oneself requires a long period for its perfection, but teachers have not known much about guiding the pupil while he is passing through this period. In fact, the years during which silent reading is maturing have been treated as though they were years of formal and uniform drill. One reads in the books on methodology the statement that the fifth and sixth grades should be devoted to drill in order that the habits acquired in the primary grades may be thoroughly fixed. Such a statement is utterly misleading. Nothing could be less desirable than that the habits cultivated in the

primary grades should become fixed. Most of the primary habits are in the nature of intellectual scaffolding and will have to come down sooner or later. Primary habits should be superseded by mature habits. The fourth grade and the subsequent grades are fruitful periods of education if teachers recognize the unique psychological adjustments that these grades have to work out. To lump together all of these significant adjustments under the blind word 'drill' is to attempt to define a complex psychological epoch by a simple, formal name. What school methods will have to do is to break up the word *drill* into a number of separate kinds of happenings. These happenings will be first distinguished by the discriminating mind, but, once they are distinguished, the methodology of these grades will be determined, and the reasons for the variety in methods will become common traditions in the schools.

"If one may hazard a general practical conclusion on the basis of the material which has been collected, . . . one may distinguish the fourth, fifth, and sixth grades from the primary grades by assigning to the latter training in intelligent oral reading, with gradually increasing emphasis on silent reading. There must be throughout emphasis on apprehension of meaning. To the fourth, fifth, and sixth grades may then be assigned the task of cultivating fluent silent reading of various types in preparation for later elaborate forms of analytical study. The grades immediately above the primary should, under this distinction, be grades of much reading of a variety of material. There will, perhaps, be a period of extensive reading of biography with suggestion as to items for which one should look. There will, perhaps, be another period when pupils will find out the best ways of getting at scientific materials and absorbing them. There will be a period of training in the reading of mathematical material. This statement should be taken literally as a suggestion that someone write an interesting book on arithmetic intended really to be read. There will be no difficulty in finding many other like topics with which to fill a fruitful program for the reading of the middle grades if teachers will once begin to think in terms of silent reading and its different forms.

"The fourth, fifth, and sixth grades are probably not periods of elaborate analytical study. It would seem to be natural to give a

great deal of mental content before attempting analysis of content. . . ."

Reading Consists of Many Different Kinds of Acts. "One has no right, however, to hold dogmatically to such a suggestion. The scientific attitude toward applications of scientific distinctions is one which leads to experimentation. The only conclusion that can be reached with absolute assurance is that the teaching of the grades above the primary must be directed to a definite, detailed consideration of a series of distinctions that break up silent reading into many different kinds of acts. These many acts require systematic cultivation by methods appropriate to their character.

"After mastery comes use. The art of silent reading having been measurably perfected in the fourth, fifth, and sixth grades, the next problem is to carry reading into its various possible applications."

Textbook versus Library. "Here we encounter what is perhaps the most dangerous obstruction to a rational reading program, namely, the conventional American textbook. The ordinary textbook is not written to be read. It is made up of compact, abstract statements and lists of items. The student cannot cultivate, while trying to use such material, habits of fluent reading. He will constantly be making analyses in order to get the details of each line. The assumption seems to be that the limitations of the textbook will be overcome in recitation period when the teacher is supposed to fill in the outline presented in the textbooks with informing illustrations. Even if this assumption were in accordance with practice, reading habits would still suffer from lack of proper cultivation, for the recitation is seldom, if ever, a period of reading.

"In sharp contrast with both the recitation and the minute analytical examination of the materials in the textbooks is the library method of getting an education. In the last few years teachers have come to realize that the pupil trained in library methods has a kind of intellectual independence which is most valuable. High schools have shown their appreciation of this new method of instruction by adopting an unsystematized use of the library. Ordinarily teachers do not go with the pupil to the library and guide him in the methods of effective use. They send the pupil and depend on chance for results. Even under these conditions very promising returns come from library assignments.

"The fortunate effects of library work are likely to lead in due

time to changes of far-reaching importance in school methods. Teachers will soon begin to realize that library methods are not only worth cultivating but also worth cultivating systematically and by carefully formulated methods."

Analytical Study. "Along with fluent reading of much material will have to be cultivated analytical study. What has been said in earlier chapters regarding analytical study should not be misunderstood as a plea for the termination of all school efforts to cultivate analysis. There is no justification for the elimination of analysis. What must be done is to find a proper opportunity to perfect analysis. Neither analysis nor reading will be properly cultivated if they are confused with each other. The distinction is of the highest importance as a guide to proper methods.

"Numerous examples of the confusion of analysis with reading to the marked disadvantage of both can be found in the schools. The English classics, which are supposed to be read by high-school students in order that they may become acquainted with the best social traditions and ideals of our race, have been prostituted to the uses of grammar and the most formal rhetoric.

"Science, which, in the hands of a Huxley, can be made the most fascinating kind of reading, prides itself in some cases on its utter formlessness and its repellent modes of exposition.

"As for algebra and geometry, the ordinary teacher would think it strange if one prophesied that some day someone will write a book on these sciences that can be read. Why should this not be possible, as well as that the individual mathematician, when not operating in his professional capacity, should sometimes in a purely personal way give his lay friends a few glimpses into the meaning of Euclidean assumptions and of such mathematical concepts as infinity and zero?

"Without attempting to exhaust these remoter possibilities, however, it is perfectly clear, in the light of facts now at hand, that the high school should draw some distinction between reading and analytical study. There is a time and a place for each. For example, when a pupil takes up an assignment in history, what shall he do—read it through first fluently and without analysis of details or begin at once to pick out and arrange in order all of the minutiæ? It is fair to assume that at the present time the conscientious student considers it immoral to read through an assignment rapidly for the sake of getting a general sketchy idea of the

whole matter. The only pupil who has the hardihood to read the lesson rapidly is the one who is caught with only a few minutes in which to prepare as best he can for the recitation. Yet it is not only quite moral, but probably very advantageous that the pupil read rapidly the whole assignment before he comes back to detailed analysis.

"Again, there is ample justification for a plea that much reading of English classics be encouraged, with all analysis omitted until the pupil gets some habits of appreciation. Suppose that he does not understand every passage the first time he reads it, or even the second time. Let anyone who has really matured in his taste for some aspect of literature describe the pleasure of the discoveries that come with re-reading, and the proper method of dealing with literature in the schools will begin to be understood. The time ought to come in our schools when there will be much reading of belles-lettres in the school unmixed with rhetorical pedantry."

Reading of Foreign Languages. "The literary studies which carry the student into foreign languages present many a complex problem. The results of photographic studies of French and Latin reading and analysis reported in this monograph show in a very striking way how the oldest subject of instruction in our high schools has set an extreme example of a type of treatment wholly opposed to reading. Pupils do not read Latin. One can dismiss as absurd under existing conditions the idea that the ordinary pupil ever gets any literary thrills out of Latin. The whole subject has degenerated into an absolutely formal exercise in linguistic dissection. It is doubtful whether this generation of Latin teachers can be made to understand the extent to which they have ruined their subject. If the war had not put an end to the rapidly increasing study of German in the schools, it is doubtful whether Latin could have saved itself, even by this date, from the fate which has overtaken its companion, Greek.

"It is nothing less than preposterous for schools to consume the time of students and leave them with the handful of ashes that Latin gives them in its present third year. Latin has lost its vitality. It is a series of barren exercises in analysis of grammatical forms; students are kept busy in the mere piecing together of English words picked out one by one from a vocabulary. It is the example par excellence of lean years of analysis that have fed

without profit on all the accumulations of a child's intellectual life.

"It would be less harmful to the school if Latin could be isolated and treated in terms of its own decline. But under existing conditions, it is a source of contagion to the whole school. Latin dominates all of the literary subjects and by its methods contaminates the procedure in every class where its influence is felt. There is a stiff and rigid analytical formalism in much high-school work because teachers in the literary fields think they must be as Latin teachers are.

"There must be a time in the study of a language when students and teachers alike want to get some meaning from the text. The French teachers may not be perfect in their art, but the French students show that they are able to read and that they are interested in the story told by the French words. French teachers have had a hard time emancipating themselves from the Latin traditions. Some of them have not yet achieved liberation, but the time is coming and seems to be at hand when the French teachers will take one fork of the road and leave the Latin teachers to go their lonely way.

"With such suggestions as these, the task of the experimental psychologist is to turn over to the schools for fuller refinement and use the distinctions which his laboratory investigations have established. This is not the place where one may properly assume to prescribe school procedure; that task must be left to experimentally accumulated experience. The present study has contributed to teaching methods only indirectly. It has set up distinctions in silent reading and has tried to amplify its own findings by suggesting examples other than those with which it deals directly. It is hoped that the classroom teacher will not be alienated by the fact that the distinctions with which this study has been chiefly concerned were made with the aid of elaborate scientific apparatus. It is always most arduous to draw the initial distinctions in any field. Scientific apparatus is essential to first studies. Once the initial distinctions have been drawn with aid of rigid scientific studies, the later distinctions become increasingly easy of discovery and description."

[Judd and Buswell, *Silent Reading: a Study of the Various Types*, Supplementary Educational Monographs, University of Chicago, XXIII (1923), pp. 152–157. By permission.]

Individual differences in ability to learn to read are very great, and these differences in so basic a subject as reading need to be understood, and methods need to be modified accordingly. The passage which follows is the result of an intensive study of children who were defective in reading, and shows how various may be the causes for such retardation. Suggestions for remedial measures that may be attempted in such cases are also given. Some of the important causes for lack of success in learning to read are discussed in the following extract.

4. CAUSES OF INEFFICIENCY IN READING

"*Inferior Learning Capacity.* The fact is commonly recognized that many mentally defective children are unable to learn to read. In a large number of schools these pupils are assigned handwork and constructive occupations of one type or another in order to train them, if possible, to earn a living. On the other hand, there are many children of low native intelligence who have sufficient capacity to learn to read effectively, but who fail because they do not receive appropriate instruction. The following report of a second-grade boy who had been in school for several years without learning to read emphasizes the importance of appropriate classifications and very simple remedial instruction.

" 'In one second grade the intelligence tests showed that the pupils ranged from moron to very superior in ability. They were arranged into groups as homogeneous as possible, taking into account the results of the tests, the scholarship records, and the judgment of the teacher. The members of the slowest group learned more rapidly when taken from the regular classes. One boy with an I. Q. of 52 had been in school for a number of years without being able to read at all. In a group where other children were not greatly superior to him, he learned to read easy material. Until this arrangement was made the teaching went entirely over his head. On the other hand, the brightest group did much more than the normal amount of work for the second grade. Six of the brightest pupils were put into the next higher grade, and their present success indicates that they will continue to advance at more than the normal rate.'

"*Congenital Word Blindness.* Some children who are otherwise normally endowed experience extreme difficulty in learning to

recognize printed or written language. This difficulty has been defined as congenital word blindness, or dyslexia. It refers to inability to understand and interpret symbols rather than to inability to see them and is attributed to imperfections or lack of development of those areas of the brain which normally serve as centers for recording images or memories of printed or written symbols. The fact that cases of dyslexia have been found in several generations of the same family suggests that it is a hereditary trait. . . .

"In discussing practical suggestions for the school treatment of cases of dyslexia Wallin says,

" 'Word-blind children who are not feeble-minded should be assigned to special reading disability classes, where various methods and devices of teaching reading may be tried out. We shall find that some children may be tired out. We shall find that some children can be reached by certain methods, while others can be reached by other methods. When it has been shown, however, that a child cannot be taught to read by the intensive application of various methods of teaching reading, the school branches should be presented orally. In fact, one of the advantages of assigning a word-blind child to a reading disability class is that he may secure from the teacher's lips the instruction which fits his level of intelligence and which he cannot secure through the printed page because of his inability to read.' *

"There are wide differences in the character and severity of cases of dyslexia. For illustration, 'Word blindness may affect only letters or Arabic numerals, or certain groups of letters or figures, or certain syllables, or whole words or certain groups of words, or certain languages but not others.' It has been suggested that such cases are due to partial interruptions in the connecting fibers between the primary (apperception) and secondary (memory) brain centers.

"In certain cases loss of ability to read takes place through injury or disease. This is technically known as alexia and is due to lesions in the left angular gyrus which is the area of the brain which 'has been fixed upon as the center for recording images or memories of printed or written words.'

"*Poor Auditory Memory.* Some pupils are unable to hear at all

* Wallin, J. E. W., "Congenital Word-Blindness: Some Analyses of Cases," *The Training School Bulletin,* Sept.-Oct., 1920.

and must be taught to speak and to read by methods appropriate for deaf children. Other pupils hear indistinctly and frequently fail in reading because they are not seated so they can hear the pronunciation of words clearly. Teachers should be on the alert for such cases and should provide appropriate seats and individual instruction to clear up difficulties. A somewhat more subtle difficulty is failure to remember what has been heard. This frequently results in inability to remember the sounds of words and consequently in confusion or even complete failure in reading. The following case reported by G. W. Willard, Seattle, Washington, describes somewhat briefly the unusual technique which was used in securing improvement in the reading accomplishments of a girl who had poor auditory memory.

"A girl ten years of age, who entered school at six and attended regularly four different schools, had great difficulty in reading in the second reader. She was tested at the Child Study Laboratory and found to have normal mentality, but very poor auditory memory. The child would sound a letter and call it another letter. The teacher soon found she had no conception whatever of phonics, and in fact could not pronounce a word after the teacher had sounded it. She also had difficulty in making the right sounds. She evidently had never learned to listen, and various methods were tried but of no avail until the method used with deaf children was tried. The child would put her finger tips on the teacher's throat to get the vibrations. By this method the child got an idea of sound, and since she had unusual rhythm, that was utilized in the phonetic work. Her difficulties were gradually overcome. She was returned to her grade and at present is having no difficulty.

"*Defective Vision.* The fact is recognized that permanent serious defects in vision frequently preclude the possibility of learning to read. There are, however, many failures in reading each year caused by defective vision which could be remedied through the use of appropriate lenses. The following description of a third-grade boy who was unable to score in any oral reading before he was supplied with proper glasses emphasizes the importance of careful examinations of the eyesight of children who encounter difficulties in reading.

"A third-grade boy was unable to make any score on the Gray Oral Reading Test. Since he was suspected of being feeble-minded, he was given the Binet test. This test showed him to be

normal mentally; and accordingly further effort was made to find the cause of his poor reading. His eyes were tested with the letter chart and seemed normal. When questioned, however, he reported that the letters looked as if 'someone had put a wet blotter on the book' and blurred them. His eyes were treated and fitted with glasses; and at the close of one year he scored 39 on the Gray Oral Reading Test.

"*A Narrow Span of Recognition.* A narrow span of recognition, which means the recognition of a very short unit of a printed line at each fixation of the eyes, frequently explains slow rates of silent reading and monotonous, inaccurate oral reading. C. T. Gray has made a series of investigations to determine whether or not the span of recognition can be increased through the use of short-exposure exercises and speed drills in silent reading. In commenting on the results of short-exposure exercises, he makes the following statements:

" 'It seems that positive results can be obtained if the training is undertaken as early as the fourth year. In the light of these facts it may be repeated here that without doubt the type of training which is given in primary work by means of the flash cards is a very important element in the early training in reading. It is also clear that the foregoing results indicate the desirability of a better grading and control of such work. Incidentally the results make it clear that training must come at the time in a child's development when it can produce results. Late training is often not effective.' *

"*Ineffective Eye-Movements.* Pupils frequently fail to establish the habit of moving the eyes from left to right along the lines and of making accurate return sweeps from the end of one line to the beginning of the next. These failures may be due to word or meaning difficulties, to poor coördination of the eyes, to poor instruction, to guessing, or to carelessness. . . .

"*Inadequate Training in Phonetics.* Recent experiments have shown that some children are able to learn to read very well without any systematic training in phonetics. Other children in the same class fail because they are unable to recognize words independently, but when given supplementary training in phonetics

* Gray, C. T., *Types of Reading Ability as Exhibited Through Texts and Laboratory Experiments*, Supp. Ed. Mon., Vol. I, No. 5, August, 1917. By permission of the University of Chicago Press.

and word analysis they are able to make up their deficiencies. The following case reported by G. W. Willard, Seattle, Washington, illustrates the large amount of help which one child received through individual instruction in phonetics.

"A girl of eight years of age in the second grade was unable to read. She was tested at the Child Study-Laboratory and found to be normal mentally, and she was also normal physically. She entered the Restoration class. Study showed that she had no phonetic foundation and was unable to memorize all the new words introduced and consequently was very much confused. An attractive phonetic chart of the various families was made. Little stories were introduced to arouse the child's interest. A game was organized in which the teacher sounded words and the child pronounced them. This was played for two weeks until the child expressed a wish to change the game and sound the words and have the teacher pronounce them. It was discovered that the child had a real fear whenever she was asked to sound words. Confidence being established, she was taught to read and was returned to her grade in two months. The report shows that at present she is having no difficulty.

"*Inadequate Attention to the Content.* In contrast to the case which has just been described, many pupils fail in reading because they give too much attention to word recognition and not enough to content. Inadequate attention to the content proves very disastrous in many cases, resulting in ineffective oral reading and poor interpretation in silent reading. The summary which follows illustrates the need of giving more emphasis to the content in many cases.

"The conclusion was arrived at that for this child, at least, phonetic drill had been carried beyond the point where it was useful. Instead of being the means to the recognition of word meaning it had become an end in itself, and really blocked the recognition of word meaning. The treatment, therefore, had as its first object the short-circuiting of this roundabout association and the attempt to develop a more direct association between the sight of the words and their meaning. For the time being, then, all phonetic analysis was abandoned, but later on some attention was given to the syllabication of words in order to develop the recognition of the typical sounds represented by the different letter combinations. But this analysis was always made with real words,

and the habit of recording letters as mere sounds was broken up.

"*An Inadequate Speaking Vocabulary.* Foreign-born children and children reared in homes where a foreign language is spoken frequently fail in reading because of inadequate speaking vocabularies and poor language habits. The case which is reported in the following paragraph is an excellent illustration of a foreign child who was seriously handicapped in reading because of a meager speaking vocabulary.

"This boy was in the third grade when the study began of his case. Polish was the only language spoken in the home and mail-order catalogues were the only reading materials found there. He did not enter school until he was approximately nine years old. On account of his size and age he was placed in the second grade and transferred the following year to third. When given the Gray Oral-Reading Test he made fourteen substitutions in three paragraphs. They entirely destroyed the meaning of the paragraphs and showed clearly that reading was for this boy merely a process of word calling. Remedial training was given first in oral reading and word analysis. These were soon discontinued for a time in favor of conversation lessons about things in which he was interested. 'Topics relating to the making of a kite, fishing, etc., were discussed. At the close of a period the discussion was summed up in a few sentences which the teacher wrote upon the board as the boy gave them. This was then made the story for the oral reading in that lesson.' Numerous types of language and informal reading exercises were given before readers were used again. When lessons were finally assigned from them, stories were chosen of boys' experiences and of animals from the Elson First Reader and the Beacon Second Reader. 'Each lesson showed a slow but gradual growth in reading power.'

"*A Small Meaning Vocabulary.* American children frequently live in communities and homes in which they hear only a very limited speaking vocabulary. As a result they early encounter words in their reading lessons which they may be able to pronounce but which they do not understand. Consequently they fail in the interpretation of many passages. The following report describes the case of a seventh-grade pupil who ranked low in comprehension because of a small meaning vocabulary.

"This seventh-grade boy was fourteen years and ten months old when his training began. 'His teachers report him as a shy,

timid boy, easily embarrassed, lacking in self-confidence and initiative in the classroom, though very energetic and responsive on the athletic field. . . . He reads in a dull, monotonous tone, slurring words and phrases. When asked to tell what he has read, he reproduces a few ideas in short, scrappy sentences, for apparently he makes few associations as he reads. His teachers in history and geography explain his poor standing in their subjects as attributable to inability to get ideas from the text. He apparently reads as rapidly silently as any in the class but gets and retains less of the thought.' A careful diagnosis of the case led to the conclusion that he had acquired ability to pronounce words which exceeded very much his ability to understand their meanings. Remedial training was carried on for eighteen weeks for the purpose of building up a background of meanings and of improving his ability to understand what he read. Oral- and silent-reading lessons were assigned; words were studied in the context for meaning; and detailed studies were made of prefixes, suffixes and stems. At the conclusion of the training period tests were given again in both oral and silent reading. The remedial instruction had apparently affected the mechanical side of his reading very little. On the other hand, there was marked improvement in his comprehension of what he read.

"*Speech Defects.* Speech defects have been reported as responsible for failures in oral reading. For illustration, a report was received concerning a boy who talked through his teeth and distorted his mouth to such an extent while speaking or reading that he was considered a complete failure in oral reading. The report which follows describes the case of a third-grade boy who stuttered. The case was reported by Miss Margaret Yazer, Virginia, Minnesota.

"John is a nervous and self-conscious child. He has always stuttered, but this handicap has been more serious since an attack of diphtheria. Very remarkable results were obtained by reading aloud with him, allowing him to skip or stop whenever he wished to. He recovered quickly as a rule and continued to read. As these exercises continued he encountered difficulty less and less frequently. After several months, his teacher submitted the following report:

" 'His improvement as to stuttering continues to be very marked. At present he volunteers to recite all by himself, a thing

unheard of before. He does not always succeed, and it seems to me that two factors enter in when he fails: (1) Excitement, embarrassment or nervousness may bring back the old stuttering habit. (2) There is a decided difference in his success based on the particular word that he chooses with which to begin his opening sentence. All words beginning with b, p, l, a, and o were practically impossible for him at first. They produced a dead halt and paroxysms of the throat, often followed by complete rout and confusion. To-day, due to a little game constantly played by himself and the teacher in a jolly way, he recognized these letters as definite obstacles to be overcome. He has completely mastered p and l and is never entirely defeated by the others.'

"*Lack of Interest.* Many cases have been reported in which failure was attributed to lack of interest or to a positive dislike for reading. In some of these cases, it has been found that lack of interest in reading was due to some fundamental difficulty such as dyslexia, poor auditory memory, or visual defects. The following case which was reported by Miss Gracia Moss is typical of many similar cases in which lack of interest is due to a combination of causes.

" 'The subject of this study was ten years old when the investigation began. Her school history revealed the fact that she had always been considered a poor reader. The first time we had a silent-reading period she looked bored and disgusted. On inquiry it was found that she had never been taught to read silently and that she had been required to give her attention mainly to the correct pronunciation of words and had never had her attention directed to meaning. When she was asked to read for herself, she replied, "I hate reading and I'll always be a poor reader." The most important problem in remedial instruction was to stimulate a real interest in reading. A simple story of adventure was chosen first and read with her. She showed some signs of interest. A number of stories were begun in class and she finished them herself. In a short time she had a book on her desk all the time, and when her other work was finished she read silently. She found in time that she could derive pleasure from reading and that she could read selections silently which she could not read aloud successfully. By the end of the third month she had read twenty-five books in the school library and was securing books regularly from the city library. At the end

of the first semester she was not only an effective silent reader but had also become a very good oral reader.'

"*Guessing versus Accurate Recognition.* Some pupils who encounter difficulties in learning to read adopt various devices for making satisfactory recitations, such as memorizing the passages read by other children. G. W. Willard, Seattle, Washington, describes the case of a boy who depended on guessing to such an extent that he failed notably in independent reading. The report illustrates the great value of a strong motive in overcoming poor habits and in establishing appropriate ones.

"A boy entered school at six years of age in 1919 and remained in the first grade until February, 1921. He was tested by the Child Study Laboratory and found to have normal intelligence. He was sent to the Restoration class. It was found upon investigation that he had a reading vocabulary of twenty words. He had a very bad habit of guessing. It was discovered that he was very much interested in animal stories. With this as a cue, animal stories were read to him. He made an animal book by cutting out and pasting pictures of animals. Then he was told simple stories about animals. These the teacher printed in his book. After two weeks, the boy wished to print his own stories. The teacher printed the stories on the board and the boy with a small printing press printed the stories in his book. This book he was so proud of that he wished to take it home so he could read the stories to his mother. The motive was sufficiently strong to help him break up the habit of guessing. In six months he was reading in the second reader. He was returned to his grade and is having no difficulty.

"*Timidity.* Numerous cases have been reported recently of failures due to timidity or lack of confidence. The case described in the following paragraph was reported by G. W. Willard, Seattle, Washington.

"'A boy eight years of age of normal intelligence had attended school two years regularly and was still in the I B class. Teacher's report: Very poor word memory. No phonetic sense Stubborn. Does not enter into any of the school activities. Will take no part in the conversation. He entered the Restoration class. The teacher found the boy to be extremely timid. For two weeks he answered in monosyllables. Various pictures and stories were used to find his line of interest. His interest was

discovered when the picture of a Red Cross dog was shown to him. Using this as a cue, all sorts of pictures and stories of other dogs were used. At last a book was given to him and he was asked to read the story. In place of reading he told the story from memory. Confidence was established and the rest was easy. It was discovered that the boy had a good sense of sound and by individual work a phonetic basis was laid. The rapidity with which he progressed led us to believe that it was extreme timidity that was at the root of the trouble. He was returned to the second grade and the follow-up report shows that he has had a double promotion and is a fluent reader.' ''

[Gray, W. S., *Remedial Cases in Reading: Their Diagnosis and Treatment*, Supplementary Educational Monographs, University of Chicago, XXII (1922), pp. 12–21. By permission.]

QUESTIONS

1. Discuss the relation of lip and throat movements to reading.
2. What is the value of expectancy in reading? What makes it possible to expect that which has not yet been experienced?
3. In what sense is it true that the rate of speed at which we read is more important than what we get out of the reading?
4. What is the function of pictures in conjunction with reading material for children?
5. Why is it dangerous to have children read words they do not understand?
6. How may speed in reading be increased without sacrificing understanding of what is read?
7. What is the distinction drawn by Judd and Buswell between analysis and reading? How do they apply this distinction to school methods?
8. Enumerate and discuss some of the causes of deficiency in reading.

CHAPTER XV

SPELLING

As in the case of reading, an understanding of the psychology of spelling is to be arrived at chiefly through processes of analysis. The student will find Tidyman's account of the various factors that are involved in spelling, and of the way these factors are to be utilized, a clear and fairly complete survey of the subject.

1. PSYCHOLOGICAL BASIS OF SPELLING

"The ultimate aim in the teaching of spelling is to give the individual such control over the ordering of letters in words that the expression of thought in writing may go on freely and accurately, without attention to mechanical details. In short, it is the automatic control of the means of written expression. This is the standard by which the teacher selects and judges her methods of teaching; it is the goal to which she directs her efforts. An analysis and description of the mental processes involved in this intimate relation between thought and the written word, and a description of the steps by which it is reached, is the task of the psychology of spelling.

"*Mental Imagery.* Visual and auditory images. Our knowledge of word forms, like all other knowledge, comes to us through the senses. We do not taste or smell words, and people in possession of their full powers do not come to know words through the sense of touch; but we do see and hear words. All word forms that pass into the mind must take one of these routes, the eye or the ear. So entering, they form pictures in the mind and as such are retained.

"Motor Images. Word pictures are not only of the visual and auditory type. Words are spoken and written as well as seen and heard. The former as well as the latter form distinct impressions on the mind, which we call mental images. Unlike merely hearing and seeing a word, the oral or written spelling

of it brings into play definite sets of muscles. In oral spelling the muscles of the throat are at work; in written spelling, the muscles of the hand and arm. It is claimed that in the writing process at least 150 muscles are involved. These muscular movements are recorded in the brain, forming the basis for motor images of words. These motor images are explained thus: the oral or written spelling of a word involves a definite and specific series of adjustments of the muscles of the throat or hand; the same series of movements is called into play every time the word is spelled, so that by repeated use a particular series of movements comes to be associated with a particular word; just as no two words look alike to the eye or sound alike to the ear, so no two words feel alike to the throat or hand; that is to say, each word comes to be associated with a certain distinct kinesthetic image of the arm or throat in making a particular series of movements, thus attaining a motor individuality of its own.

"The part that motor images play in learning spelling is a significant one. When the series of movements for each word has become completely established through frequent use, as in the writing of common words, we no longer need to think of individual letters as we did in the original learning. One nervous impulse is sufficient for the whole word. The thought of the word or of wanting to spell the word sets the machinery in motion and the word, as we say, spells itself. It is through the service of motor images that spelling is finally made automatic. Motor imagery aids also in forming clearer visual and auditory images, in the way that expression strengthens impression. In writing, the eye, by following the point of the pen, gets a detailed and accurate impression of the word each time the word is repeated. Finally, motor images serve as additional bonds of association in the learning of words.

"Mental images of spelling words should not be confused with mental images of words involved in hearing, speaking, and reading. The processes of hearing, speaking, and reading words involve mental images of a different sort from those used in spelling. They are images of whole words, while the imagery immediately involved in the spelling of words is the imagery of the order of letters. The peculiar task of spelling is to associate with pictures of whole words, which are already a part of the child's experience, detailed images of the order of letters.

"Preferred kinds of imagery. In learning the spelling of words it is possible to employ several kinds of word pictures. From our previous discussion it is clear that such pictures must include the eye or the ear on the one hand, and the throat or the hand on the other. With the eye may be associated movements of hand, throat, or both hand and throat. The same is true of the ear. Also, the eye and ear together may be associated with movements of hand, throat, or hand and throat. While, theoretically at least, there are nine possibilities in the combination of word images, certain combinations are preferred to others. In general the eye is preferred to the ear, and the throat and hand, while of no practical value for independent use, are a direct and positive aid to either eye or ear.

"Individual differences in imagery. While this is true, speaking generally, the preferred type of imagery is yet more or less an individual matter. Common observation shows that there are some persons to whom the natural method of verifying the spelling of a word is to spell it orally to themselves; others must see the word before them; while still others must write the word. That is, people naturally employ different kinds of imagery in doing the same kind of mental work. At least three types stand out; namely, visual, auditory, and motor. Of the last, two types are distinguishable, speech-motor and hand-motor. The practical implication of this fact is that methods of teaching do not have the same value for all children. They vary for different individuals according as they are favorable or unfavorable to the dominant type of learning. The best method of presentation is a matter of getting for each person the right combination of the processes that may enter.

"*Order of Mental Processes in Learning Spelling.* The exact mental processes employed in spelling have been made the subject of experimentation by trained observers. As nearly as they have been determined, these processes appear to be as follows: Preliminary to the spelling exercises, ideas have been associated with auditory, visual, and speech-motor images of whole words. The first step in spelling is to get a clear, accurate mental picture of the whole word in visual, auditory, and speech-motor form. These are already closely associated in the mind, so strong is the connection between the perception and the oral expression of words. For example, it is said that in silent reading, instead of the

idea being associated directly with the written symbol, the written symbol calls up the speech-motor image of the word and the latter calls up the idea. In the second step the word is broken up into syllables. With the clear visual imagery of the syllable, it is usually pronounced. With the visual and speech-motor-auditory image of the syllable is associated a visual image of the letters in order. The visual image of the order of letters is associated with the throat movements necessary to spell the word orally, and the hand movements necessary to write the word.

"*Individual Variations.* From our knowledge of mental types, we do not expect these processes to be the same for all pupils. For example, a pupil leaning strongly toward ear-mindedness might associate the letters of a syllable directly with the sound of the syllable, without having the visual image.

"Ordinary adult observers may fail to discover each of the steps in their own conscious experience. As learning approaches the stage of habituation, the tendency is for the written form to become more and more directly connected with the idea, due to the dropping out of some of the intermediate steps. The mental processes involved are best shown in the recall of a forgotten word or in the learning of a new word. Even here they are somewhat obscured by the intervention of familiar parts of words, such as common phonograms.

"Importance of the syllable. Another fact needs to be emphasized. A great many words, nearly all polysyllabic words, contain too many separate letters to be taken in by the eye at one glance, as is necessary for a detailed and accurate mental picture. The perception span is from three to five distinct objects. Therefore, the syllable is important in learning, since it at once divides the word into a number of perceivable units and at the same time makes possible a clear, definite, detailed picture of the letters.

"*Spelling as Habit Formation.* Spelling, as we have seen, involves the association of mental images of words. Learning of this kind, which has in it less of thought, variety of content, and originality, and more of the repetition of certain set forms or movements, is learning of the habit-formation type. It consists primarily of the association of certain arbitrary symbols, and then of practice in making these symbols until they can be made automatically, or 'without thinking' about them. The emphasis

in learning is upon exercise and effect. The principles for the formation of habit are vivid picturing, attentive repetition, and automatic control. These principles represent also the steps or stages of learning.

"*Vivid Picturing.* The ease of habit formation depends in the first place upon the strength of the mental push with which the child is started. Vivid word pictures, like vivid experiences of an unusual and thrilling nature, such as an automobile accident, make lasting impressions on the mind. The strength of the impression, as in other phases of learning, depends largely upon the child's interest. Therefore ways and means of adding interest and enthusiasm to the work are an important consideration for the teacher. To add vividness, the word under investigation may be made to stand out from other words by letting it assert its individuality. We do this by picking out the common elements of the word, by pointing out its peculiar difficulties, by associating it with other words of similar form, and by a variety of other devices that will appear in succeeding pages. Further, the strength of the image will be increased by appealing to the pupil's dominant type of word imagery. If a child is visual-minded, then visual presentation is better for him; if ear-minded, then auditory presentation will have the most lasting effect. Since visual learners are in the majority, visual presentation should be the basic method. Lastly, variety of presentation is equally important. There is no such condition as pure ear-mindedness or pure eye-mindedness. A child may be more strongly inclined toward one mode of imaging than another, but all modes are present to some degree. Therefore all methods of presentation will be effective to some extent. The effect of variety will be a multiplicity of appeal which we recognize as an important principle in learning. Moreover, a variety of methods of presentation is necessary to provide for the children who belong to the exceptional imaginal types, the ear-minded and the motor-minded individuals.

"*Attentive Repetition.* There is a period of learning between the first clear picturing of the word and the use of the word freely in expressing thought when the child must focus his attention and effort definitely upon fixing the image of the word in mind. This is the beginning of the drill or practice stage in learning. In order to be effective this first drill work must be

accompanied by a high degree of attention. Otherwise, not only will there be little improvement, as is shown by studies of the curve of learning by Book, Bryan and Harter, and others, but also through carelessness mistakes will be made, the correction of which will require the expenditure of additional time and energy. A good example of what a drill should not be is seen in the old 'assigning lessons' method of teaching. Frequently the child in a spirit of any-way-to-get-through-with-it, wrote the word the prescribed number of times, with increasing illegibility if not inaccuracy. The formal demands of the teacher were scrupulously complied with, but the result was an increasingly distorted if not actually erroneous mental picture of the word. It is not mechanical repetition, but repetition with attention, that facilitates the process of habit formation.

"As in case of the original presentation of words, attention is to a considerable extent a condition of the child's interest in the work, and time spent in making spelling significant and attractive to children is in the long run time well spent. Equally important is the active direction of the beginning drill work by the teacher. Only thus may the teacher be sure of the active attention of the children. This work is often closely associated with the presentation of the word and is a regular part of class study. The drill should be short, spirited, varied.

"*Value of Trial Recall.* In this phase of the work the child not only is shown the word or told how to spell it, but also is allowed to spell it by himself. Active recall is better than additional presentation from without. This is a helpful way of securing close attention and forms the connection in the way in which it will be used. Such recall, also, shows the child when he does not know a word and allows him to distribute his time among the different words of the lesson according as they are easy or difficult.

"*Automatic Control.* There is no abrupt break between attentive repetition and automatic control. With repetition and use there is a gradually decreasing amount of attention, and consequently more and more automaticity. The mind is increasingly freed from the necessity of directing the ordering of letters and is left free to follow the thought. But for most persons perfection of skill is never realized in spelling even the commonest words. The more we become absorbed in thought and composition, the less sure

we are of the spelling of words; rather, the surer we are of incorrect spellings. Few of us would want a first draft turned over to the printer. Yet for practical purposes we may regard a word as learned when it is used freely and with a high degree of accuracy in ordinary composition, such as letter writing; and, when attention is especially directed to spelling, as in going over a sheet a second time, misspellings are readily detected and corrected.

"The power of automatic or habitual spelling of words is developed by frequent repetitions of words in special drills or as they occur in ordinary composition. It is not a power which is fully developed in school or which ends with the school. It increases with use throughout life."

[Tidyman, Willard F., *The Teaching of Spelling* (World Book Company, Yonkers-on-Hudson, New York, 1919), pp. 31–39. By permission.]

Much of the time devoted to the teaching of spelling must be given up to the correction of misspellings. Special studies of the causes of misspellings have been made that throw considerable light on this subject. The following excerpt from Suzzallo shows how the process of correction differs psychologically from learning to spell new words, and how a knowledge of the underlying psychology applies to methods.

2. THE CORRECTION OF MISSPELLINGS

"*The Weakness of Previous Corrective Teaching.* The purpose of all testing is to discover the spelling mistakes of children. But discovery of error necessitates the correction of the fault. The older practice of teachers was strong in discovery and weak in correction. The current method of correction usually consisted in sending the child back to the correct form, and leaving him to discover the technique by which he could overcome his difficulty. Usually the child found no other technique than the mere repetition of oral spelling or the copying of the visual form a given number of times. The child exercised no ingenuity because he was incapable of diagnosing his own case; and the teacher suggested none, for he was scarcely aware that there was more to do than to drill upon the word. Such attempts at the correction of children's errors were weak chiefly because they were futile.

"*The Difference between Original Learning and Correction.* Re-learning an old word correctly, after incorrect habits have been formed, is vastly different from learning a new word about which the child has no misconception. To send the child back to the old form to 'learn it anew' is not the simple matter that is implied. Every teacher in his more thoughtful moments knows that the path from ignorance to knowledge is easier and less complicated than that from error to knowledge. In one case a habitless child forms a habit; in the other, the pupil must break one habit and form a new one through conscious effort.

"*Failure to Apply the Distinction.* The attitude of recent theorists and contemporaneous writers of textbooks shows that the distinction is by no means applied. This is clearly brought out in discussions on the teaching of homonyms. One set of authors says that all words containing similar elements should be completely dissociated, that is, studied one at a time in complete separation from each other. Another group of writers states just as emphatically that words with similar elements, which inevitably lead to confusion, must be brought into consciousness together, then compared and differentiated. Such experiments in comparative teaching as have been conducted give evidence that the first group has generalized from the teaching of new words to young pupils and that the second group has derived its principle from the correction of errors among older students. Each has made a generalization from one situation and falsely applied its truth at large. They have not made the distinction between proceeding (1) from ignorance to knowledge and (2) from error to knowledge.

"*Normal Stages in Our Progress.* Only slowly has this distinction between the presentation of new spellings and the correction of misspellings been brought to the attention of teachers. One might say that the profession at large has not yet recognized it. It is not surprising that distinctive methods for the correction of spelling errors are just beginning to be evolved. They could scarcely have appeared sooner, since the teaching of spelling, as distinguished from the recitation of spelling, is a very recent procedure. In the evolution of our spelling methods, the periods in our progress are thus characterized: (1) In the early period spelling is merely tested; (2) later it is taught and then tested; and (3) now it is taught, tested, and corrected.

"*The Psychology of Presentation Applied to Correction.* The awakening of the teacher to the idea that spelling needs careful primary presentation, just as any other subject does, was the basic step in suggesting that he must also have a special method for correct misspellings. Much of the psychology that underlies good instruction in new words is coming to be applied to the correction of mistakes. The mere fact that developmental teaching and good lesson assignments came into existence out of the teacher's desire to prevent wrong impressions and false habits, focused the teacher's consciousness upon the causes of spelling errors. It was only an additional step upon the part of the thoughtful teacher to begin to treat misspelling by special methods devised for that purpose.

"*The Gross Defects of Old Corrective Methods.* Let us look for a moment at the traditional methods employed for the correction of errors. If the child misspelled a word, the correct form was set for him on paper or blackboard. The child, looking at the form, copied it below,—ten, twenty, or fifty times, as might be required. It was purely a mechanical exercise. Each time he wrote, he scarcely thought of its meaning; he did not necessarily think of its sound. In all probability he did not translate its sounds into letters, he merely imitated the form he saw. It was more nearly an exercise in penmanship than in spelling. That it was mechanical and thoughtless is suggested by a very common experience. Every teacher has noted that a child mechanically copying words might misread the form, mistaking an e for an i, or an o for an a, thus misspelling the word. The careless misspelling was then copied in the successive repetitions. It was the kind of correction which did not correct. The teacher did not guarantee a motive for the child's effort or a means for guaranteeing a full association of all the elements involved in good spelling, —meaning pronunciation, and written form. The child's whole attention was on copying, mastering a written form out of the normal setting of its use. The result was that, in many cases, the very child who had written a word fifty times would misspell it in the composition class. There the chain of connections starts with a meaning, revives the pronunciation, and leads him straight to the old association with a wrong form because *the mistake was acquired in a normal setting.* If he had thought of his error every time he wrote the new form, the corrective work might still have

been successful, for when he started to write the old and incorrect association, the new form associated with it by the corrective repetition might have inhibited and diverted him to the new spelling. But the column copying did not even guarantee inhibition. A true correction can be made by substituting a completely new chain of associations, without aiming to use an inhibitive associate. The teacher should establish a new neural path beginning with meaning and leading through pronunciation to correct written form, and exercise it so well that it would become the path of least resistance, leaving the whole incorrect association to fade out through disuse.

"*Individual Treatment the Essence of Good Corrective Work.* The essence of good corrective work lies (1) in individual teaching and (2) in sufficient time for the formation of new habits. As long as the mass teaching of classes was our exclusive practice, any real correction of errors was impossible. One can teach new words to a whole class by group instruction, because all the children require them; but misspellings are likely to be far more individualistic in their distribution. Even when children misspell the same words, the misspellings will be different. And when the misspellings are alike, the causes will vary. The error in one case will be due to the fact that the child did not see the form correctly; in another, to faulty pronunciation; and in a third, to mere carelessness in writing. The first requirement is good individual diagnosis. The second is suggestion by teacher to child of concrete exercises designed to correct the error. These must be sufficiently simple for the child to be able and likely to carry them on by himself. And then there must be some account kept of these individual tasks, so that the teacher may re-test for the purpose of knowing if the correction has been made. The individual spelling lists, previously discussed, which are made up of words which the child either does not know and is told, or which he has actually misspelled, should be utilized to check up the efficiency of such individual corrections.

"*The Need of Time and Exercise for Habit Formation.* But it takes time to substitute new habits for old, and the average teacher is far too impatient of error to see that its causes are deep seated. It is easier to attribute error to childish perversity and to administer moral blame than to seek its psychological causes and treat them with persistent and thoughtful attention.

How often does the teacher correct the child's error at one moment and expect him to know the word the next! If the pupil slips up on the word the next moment the instructor is more likely to blame than to help, as though the pupil were morally culpable. His error is treated as a matter of sin, not as one of gradual habit formation. The child should be interested in the need to correct. He should be given considerable exercise in the normal use of the right form, so that the new habit may grow into a lusty competitor of the old. The teacher cannot get the result at once. In the early stages of correction it may be that the child will spell the word correctly in the spelling period and lapse in his composition where the mind is centered upon ideas and form is merely in the margin of attention. This is not a discouraging fact; it is rather a characteristic symptom of the first stages in reform. Later, in the spontaneous written exposition of his thought, he may be inconsistent in his spelling,—sometimes spelling the word as it should be and sometimes not. This should be a source of hope, not despair, for it marks a middle stage of growth. It is only in the last stage that the new habit becomes completely ascendant and the word is spelled with consistent correctness. The teacher should remember that there are stages of growth in correcting spelling errors as there are in everything else. A single reprimand or caution by the teacher does not correct a mistake, it merely presents the problem. Motive, time, care, and exercise are required to modify an error.

"Up to twenty years ago the characteristic activities of the spelling period were a mere examination of the child's ability to spell and a drilling upon the correct form of misspelled words. Within the last decade the prevention of error, rather than the testing and noting of errors, has become the major activity. Apparently we are now about to devote an increased energy and ingenuity to the weakest spot in the spelling lesson,—the correction of misspellings. We are ready to develop a technique which will adequately correct those misspellings which escape all the anticipatory efforts of our best teachers. It is in the diagnosis of spelling errors and in the skillful substitution of new and correct habits that we shall find our largest immediate opportunity for improving our methods of teaching spelling."

[Suzzallo, Henry, *The Teaching of Spelling* (Houghton Mifflin Company, Boston, 1913), pp. 104–114. By permission.]

Reading and spelling deal with the same materials in different ways. How much the learning of one of these activities contributes to the learning of the other we cannot yet say, but there is some evidence to believe that at least in some cases there will be a certain amount of interference produced by the one learning activity upon the other. It is at least true that one finds extreme deficiency in some cases in spelling where no such deficiency exists in reading. The psychology of special defects in spelling is discussed by L. S. Hollingworth.

3. SPECIAL DEFECT IN SPELLING

"*Coherence among Linguistic Functions.* According to Meumann, the whole field of language is a unit, psychologically considered. Reading, spelling, composition, the learning of foreign languages should thus be intimately interconnected for a given individual. He who learns one readily, should also learn the others, without notable exception.

"This view of the close coherence among linguistic functions is borne out, also, by the work of Gates, . . . in which he found high positive correlations among perceptual tests which use words as materials.

"We must notice, nevertheless, that the correlations fall considerably short of unity. Illustrative cases show that occasionally children are found who can read well, but cannot spell legibly, though the present writer has not seen cases of the opposite condition, and has not found them reported in literature.

"Special defect in spelling will, therefore, be given separate consideration, though it must be recognized that abilities in spelling and reading are usually closely associated.

"*Analysis of Learning to Spell.* It is virtually impossible for an educated adult, whose spelling habits have long ago become automatic, to reconstruct from introspection the long, difficult, and complex processes through which he passed in learning to communicate by means of correctly spelled words. Such an adult may gain some idea of what is involved in the spelling process by confronting himself with the task of learning to spell and write words upside down and backwards, but even so the experience of the child is not duplicated.

"Analysis teaches us that this aspect of linguistic attain-

ment ordinarily involves the formation of a series of connections approximately as follows:

"(1) An object, act, quality, or relation is 'bound' to a certain sound, which has often been repeated while the object is pointed at, the act performed, and so forth. In order that the connection may become definitely established, it is necessary (a) that the individual should be able to identify for himself the object, act, quality, or relation, and (b) that he should be able to recollect the particular vocal sounds which have been associated therewith. When this is accomplished, the sound has become a word.

"(2) The sound (word) becomes 'bound' with performance of the very complex muscular act necessary for articulating it.

"(3) When school age is reached, certain printed and written symbols, arbitrarily chosen, visually representing sounds, become 'bound' (a) with the recognized objects, acts, and so forth, and (b) with their vocal representatives, so that when the symbols are presented to sight, the word can be uttered by the perceiving individual. This is what we should call ability 'to read' the word.

"(4) The separate elements of the symbols (letters) become associated with each other in the proper sequence, and have the effect of calling each other up to consciousness in the prescribed order. When this has taken place we say that the individual can spell orally.

"(5) The child by a slow, voluntary process 'binds' the visual perception of the separate letters with the muscular movements of arm, hand, and fingers necessary to copy the word.

"(6) The child 'binds' the representatives in consciousness of the visual symbols with the motor responses necessary to produce the written word spontaneously, at pleasure.

"This analysis is probably not exhaustive, but it provides a foundation on which to construct an understanding of poor spellers. Obviously, poor spelling may be due to one or another of quite different defects, or to a combination of several defects. In an ability so complex there is opportunity for the occurrence of a great variety of deficiencies. In any particular case the underlying cause can be discovered only by means of a psychological examination covering the various processes involved.

"*Psychological Examination of Poor Spellers.* Poor spelling,

like poor reading, may be due to sensory defects, either of the ear or of the eye. If sounds are indistinct, or if visual stimuli are vague or distorted, the prescribed connections involving these elements will be difficult to form. Thus tests of auditory and visual acuity must be given. If any sensory defect is revealed, it should be corrected, if it is corrigible.

"The degree of general intelligence must be determined. Failure to learn to spell is frequently symptomatic of general incompetence, though not so frequently as in the case of reading. The correlation coefficients cluster around .50 only, in the case of spelling and general intelligence. Quite a number of children will be found whose achievement in spelling shows marked discrepancy with general capacity. Spelling is more mechanical than reading, so that the stupid may more easily master it by tireless drill, while the intelligent are not likely to derive so much pleasure from it or to practise it so much.

"The connections which are described in our analysis under (2) may be inadequately or incorrectly developed. This would be *faulty pronunciation.* This is undoubtedly a very prolific cause of poor spelling. Such errors as 'a-f-t-e-r-w-o-o-ds' for 'afterwards,' 'w-h-e-n-t' for 'went', 'p-r-e-h-a-p-s' for 'perhaps', will serve to illustrate this point. In observations on poor spellers, such errors are found by the score, and it is discovered that the words are pronounced as spelled. Thus the poor speller should be tested for the pronunciation of the words which he misspells. It may be that drill in correct pronunciation is what is needed, in order to improve his spelling.

"Faulty pronunciation may itself be due to various causes. In the majority of cases it doubtless arises from *false auditory perception,* as in such misspellings as 'hares breath' for 'hair's breadth,' and 'Mail Brothers' for 'Mayo Brothers.' In other cases it arises from inability to articulate properly, as with children who stammer or lisp, or have nasal obstructions.

"It may be that a pupil's weakness lies in the formation of connections, which we have noted in our analysis under (3). The formation of these connections involves visual perception, habits of interpretation through the eye, which have been found to be of first rate importance in spelling. We may refer back to the discussion of the perceptual factors in reading. In spelling, also, it has been discovered that error is not distributed at

random, but follows certain laws. For instance, there is a constant tendency to shorten, rather than to lengthen words in misspelling them. The influence of any letter over error varies greatly with the position of the letter in the word. The last halves of misspelled words show many more errors than are found in first halves. From these and other facts it is apparent that failures in visual perception contribute to the difficulties of poor spellers. In order to determine whether such is the case with a particular child, it will be necessary to make an analysis of his work, to see whether the distribution of his errors reveals such perceptual weakness. If a child can spell the first halves of words correctly, but does not spell the last halves, or if he learns to spell the upper halves of words correctly, but cannot spell the lower halves of them, the remedy is to bring about readjustments of attention, whereby he will look at those portions of words which formerly he failed, unconsciously, to see.

"Poor spelling may be due to sheer failure to remember—failure to retain impressions which were originally clearly and correctly perceived. This may mean simply that the child requires unusually numerous repetitions before he can form the connections described under (4) in our analysis; or it may be that his memory span is abnormally brief, and that he cannot easily associate more than three or four elements together as a unitary sequence. Tests of memory span for various kinds of materials should be instituted, in order to gain light on this point. If it appears that his performance is decidedly below the normal for his age, especially when the material is letters, it may be concluded that too brief memory span is probably playing a part in his difficulties. This could be checked up further by an analysis of his spellings, to see to what extent he spells short words correctly, but misspells longer words. Emphasis upon syllabication, prefixes, suffixes, and other short units should be helpful. The child might be able to remember three syllables of three letters each, but unable to retain, with the same amount of practice, one word of nine letters. Psychologically, these two tasks are different.

"Smedley suggested years ago that there might be a 'rational element' in spelling, whereby knowledge of meaning of words would contribute to the correct spelling of them, in and of itself. Connections involving meaning are considered in our analysis

under (1). Children produce an especially great proportion of error in spelling words which have no meaning to them. Hence it is of interest to test the child for knowledge of the meaning of words which he misspells. It is necessary to find out whether the words which confuse him are in his vocabulary.

"Motor awkwardness and incoördination may contribute to poor spelling. Here are involved the connections discussed by us under (5) and (6). In written spelling (with which education is chiefly concerned), it is necessary not only to know what symbols are required, but to execute them successfully with arm, hand, and fingers. Here we must have recourse to motor tests, for steadiness, coördination, and speed of voluntary movement. Occasionally one finds a child who does much better at oral spelling than he does at written spelling. In such cases, improvement in handwriting is what is needed, either in respect to rate or quality. A slow writer may misspell many words if he attempts to hurry.

"Many of the mistakes of poor spellers are merely lapses. These are errors committed by children who 'know better,' who can correct the mistake spontaneously as soon as attention is called to it. There are wide individual differences in the liability to lapse. It is difficult to see what remedial measures may be taken to improve those whose disability is due largely to lapsing, since lapses are not only involuntary, but for the most part unconscious; there is no awareness of them until one perceives them anew. Examples of lapsing may be seen in 'Complicated *musich which* he heard played,' and 'It *mak make* an impression,' for 'It may make an impression.'

"One might suggest that children who show this tendency in marked degree should be trained to lay aside for a few minutes all written communications; then to take up their work and look anew at each word, in order to correct all lapses. It is not known experimentally how long an interval must elapse in order that writing may 'get cold,' so that lapses may be detected by the author of them. A few minutes will probably suffice.

"Transfer of habits previously acquired is occasionally the cause of misspelling. Children who have learned to read and spell a phonetic language, like German, or a language that proceeds from right to left in spelling, are prone to difficulty with English spelling. The possible existence of such an influence is to be determined by taking the school history.

"Sometimes it happens that the errors of the child are of one particular kind. Such idiosyncrasies may be exemplified by the case of a child who had a strong tendency to add final 'e' to all words; and by the case of another, who was addicted to intrusive consonants, especially 'm' and 'n.' These idiosyncrasies may doubtless be traced to their source in every case by a patient analysis of the child's mental contents. The child who added final 'e' may, for instance, have been told by a careless teacher 'Don't leave off your "e's".' The cause of error will be different in every case. It is impossible to generalize about idiosyncrasies.

"After all of the foregoing factors have been considered, there still remains the possibility that the failure to learn is due wholly or partially to temperamental traits—instability, indifference, lack of incentive, distaste for intellectual drudgery. English spelling calls largely for rote learning. It can be acquired only by the formation of thousands of specific bonds, arbitrarily prescribed. Its pursuit is almost inevitably tedious. Thus many children will be temperamentally ill adapted to become good spellers.

"Failure in spelling, in an intelligent child, may thus result from various kinds of interference with prescribed habit formation. It is apparent that the psychological examination of a poor speller is neither a brief nor a simple task.

"The direct examination of the individual should be supplemented by a family history, a development history, and a school history. In some cases special deficiency in spelling seems to be hereditary. Earle has made a study of the inheritance of capacity for spelling, from which he concludes that there is a distinct fraternal resemblance in spelling. Stephenson has reported six cases of special inability to read and spell, which occurred in three generations of one family."

[Hollingworth, Leta S., *Special Talents and Defects* (The Macmillan Company, New York, 1923), pp. 98–105. By permission.]

QUESTIONS

1. Describe the relation of mental imagery to spelling.
2. What principles of efficient learning apply to the formation of associations required in spelling?
3. What is the psychological difference between original learning of spelling and the correction of misspellings?

4. Explain in detail how abilities in reading and spelling are related to one another.
5. Compare Hollingworth's analysis of spelling in terms of "bonds" with Tidyman's in terms of associations. Do they differ?
6. How should children who are deficient in spelling ability be tested?
7. Describe some of the more important sources of errors in spelling.

CHAPTER XVI

HANDWRITING

In the teaching of any subject the psychological principles to be emphasized will be to a large extent determined by the purposes the teacher has in mind. Often these purposes are so vague that both teacher and pupil view the school tasks as ends in themselves, with a resulting formality of instruction and learning. The selection which follows is a good illustration of the way in which an analysis of "objectives" may aid the selection of appropriate methods and point to the underlying psychology.

1. ATTAINMENT OF OBJECTIVES IN HANDWRITING

"*List of Objectives.* The best teaching of handwriting is based on well-selected objectives. The attainment of these objectives is the primary aim of instruction. The system of hand-writing utilized is a major device, which should be supplemented by other technical aids. Critical analysis shows that handwriting instruction involves eleven major objectives. A brief presentation of these objectives follows:

"1. Legibility—the ability to write legibly.
"2. Speed—the ability to write rapidly.
"3. Endeavor—the desire to write well in all writing situations.
"4. Ease—the ability to write easily.
"5. Automatization—the ability to write well automatically.
"6. Versatility—the ability to write with different mediums and in different physical situations.
"7. Arrangement—the ability to arrange written work effectively.
"8. Interpretation—the ability to interpret script.
"9. Criticism—the critical knowledge of the elements of effective writing.

"10. Application—the knowledge of the value of effective handwriting.

"11. System—the habitual use of care and system in the handling of writing materials.

"Legibility and speed are conventionally considered to be the most important of the foregoing objectives. As these two objectives have been treated at great length in the current literature of handwriting, it is the purpose of the present article to consider three other objectives, which, although of distinct importance, have been given little systematic attention in the leading systems of penmanship instruction. These objectives are endeavor, automatization, and criticism. A brief treatment of each of these objectives will be given in the paragraphs to follow, including a definition of each objective, a discussion of the underlying psychology of instruction, and a statement of the standards of attainment which should be set up for the several elementary grades in connection with each.

"*Endeavor—the Desire to Write Well in All Writing Situations.* Definition. Many pupils who can write well under test conditions fall back into careless and unsatisfactory penmanship when writing under ordinary conditions. This is largely brought about by the failure to inculcate the ideal of good handwriting at all times. General ability in handwriting deteriorates very rapidly unless, in gaining skill, the pupil also acquires the attitude of writing well regardless of circumstances. The objective of endeavor is less easily attained than that of either legibility or speed, but it is fully as important in the final outcome of handwriting instruction.

"Psychology. It is a well-recognized principle of learning that, in so far as possible, the stimuli which incite pupils to make efforts toward the mastery of new skills should grow out of natural situations rather than out of formal drill exercises. So far as possible, a reaction should be learned under the conditions in which it will be used for practical purposes. This principle applies to many aspects of handwriting instruction. Letters, for example, may best be introduced in their natural setting as parts of words. Numerous situations arise in connection with the general classroom activities which offer natural rather than artificial incentives for the pupils to improve their standards of writing. Pupils in the first grade, for example, wish to identify their own

products by writing their names legibly thereon; pupils in the second grades see the value of placing accurately formed figures on bank deposit slips.

"One of the most important objectives of handwriting, if not the most important, is to develop the desire to write well in all writing situations. This can best be brought about by emphasizing natural situations in which the pupil's best writing is associated with pleasant results. There has been a tendency to make handwriting largely a matter of formal drill. This practice may bring about good speed and quality of writing under test conditions, but it leaves the pupil with little incentive to write well under ordinary conditions and fails to develop his appreciation of the general values of effective handwriting. Good handwriting fits very effectively into a multitude of school activities and outside situations, a practical background out of which every teacher of penmanship should endeavor to motivate the formal drill necessary to achieve skill in execution.

"The reciprocal relation of handwriting to the remaining school subjects is exceptionally high. Handwriting functions directly as a means of communication in the great majority of school subjects. With the exception of reading, there is no other tool subject which is so largely used in connection with the pupil's general learning activities. In labeling drawings, in preparing papers, in writing tests, in solving problems, and in taking notes, the pupil finds almost constant use for writing, and the ease, speed, and quality with which his writing functions are a significant contribution to his progress in other subjects.

"There is a belief among some teachers that, while handwriting thus serves the other subjects, they in turn have nothing to contribute to proficiency in handwriting. Nothing could be further from the truth. On the contrary, with all due credit to the effectiveness of special handwriting drill, it is largely through the practical handwriting situations which arise in connection with the other school subjects that the permanent standards of the several general handwriting objectives are attained. The difficulties encountered in attaining pure skill in handwriting may best be mastered during the handwriting period, but skill in the practical utilization of penmanship is a matter of general practice, and the responsibility for such skill must be assumed by general rather than special handwriting instruction. There

is no single practice in handwriting instruction which is more conducive to generally improved handwriting than the demand that good handwriting standards be maintained in subjects other than handwriting itself. This is particularly true with respect to the combination of speed and legibility, and it is absolutely essential in the maximum attainment of the important handwriting objective—endeavor. . . .

"*Automatization—the Ability to Write Well Automatically.* Definition. Automatization in writing is a source of distinct mental economy. Many pupils who can write well under ordinary conditions when fair attention can be devoted to the act of writing permit their writing to deteriorate when under a severe mental strain—for example, when they are taking complicated notes or writing a difficult composition. Automatization should be developed by appropriate drill, particularly in the upper grades, to the point where the pupil can write within a few points of his best writing without having his attention distracted from the content of his writing.

"Psychology. It is necessary to practise handwriting exercises repeatedly in order to stamp in the skills which have been temporarily mastered. It is essential, however, to distinguish two types of drill, namely, drill for improvement and drill for automatization. In drilling for improvement, or, as it may be better expressed, in practising for improvement, the pupil repeats the exercises with a constant effort to improve his product. This effort may involve a considerable amount of variation on the part of the pupil in his endeavor to obtain an improved product. The successful outcome of his total procedure is based on his ability to maintain a critical attitude toward his product and to keep on striving for better results. Drill for automatization is a totally different process. Here the assumption is that the writing product is at a satisfactory level of achievement for the time being, and the exercise is repeated to stamp in the act as a habitual type of performance. Here the chief concern of the writer is to maintain his level of performance.

"The distinction just made between drill for improvement and drill for automatization is one of the most important of the psychological bases which underlie handwriting instruction. When pupils are drilling for improvement, they must not be permitted to lapse into unthinking repetition of the movements

involved, for the process of automatization then takes the place of improvement and the drill stamps in the very practice that it is planned to improve. In drilling for automatization, it is necessary to select letters and combinations which are satisfactory from the point of view of quality. It is then necessary to make certain that the pupil does not permit his quality to deteriorate while practising, for in this case the process of automatization stamps in the habit at a lower level than is desirable. If, for example, a pupil can write quality 60 but drops to quality 50 during drill, it is certain that he will develop the 50 writing habit rather than the 60. The process of automatization goes on with the repetition of an exercise whether for good or for evil. Great care must therefore be exercised to keep pupils from stamping in poor writing forms while they are practising for improvement. Experimental psychology has shown that the only way to overcome unsatisfactory automatizing effects of a repeated act is to associate a definite dissatisfaction on the part of the learner with the immediate outcome of the reaction. Thus, if the pupil gives constant critical attention to the writing product during drill for improvement and is dissatisfied with poor results, it is possible to avoid the stamping in of undesirable writing habits. Pleasure as a result of successful efforts, on the contrary, reinforces the retaining effects of repetition. . . .

"*Criticism—the Critical Knowledge of the Elements of Effective Writing.* Definition. Self-improvement in handwriting and the ability to maintain standards of penmanship once attained are materially aided by a discriminating knowledge of the basal elements which enter into superior writing, such as spacing, slant, alignment, and letter formation.

"Psychology. Most handwriting systems make considerable use of the device of visualization, by virtue of which pupils attempt to reproduce writing from memory. It should be kept in mind, however, that many pupils do not visualize readily. It is essential to fortify the imagery of such pupils by calling their attention to the peculiarities in shape and formation of the letters under consideration. Certain pupils, for example, who do not visualize the letter o clearly may readily recall that it is round like a dollar. In this case logical analysis takes the place of visual imagery.

"Logical analysis plays an important part in the mastery of

handwriting by supplementing the process of visualization. It is profitable, moreover, to apply the principle of logical analysis to handwriting at levels higher than pure letter formation. As the pupil advances in the course, he should be taught to analyze samples of handwriting in terms of the elements which enter into effective handwriting as a complete product. In due course of time he should be able to break up a specimen of handwriting into such basic elements as slant, spacing, alignment, and letter formation and to understand the importance of each of these items as compared with the general quality of the handwriting as a whole. In this connection it is well to rely on Gray's scientific analysis of the quality of handwriting for the standards of comparative value which should be attached to the separate elements of handwriting."

[Fred C. Ayer, *The Attainment of Objectives in Handwriting*, "Elementary School Journal," September, 1927, pp. 45–51. By permission.]

Handwriting for the adult, as in the case of all habituated forms of skill, appears simple. Professor Freeman has been able in his extensive experimental investigations of this subject to analyze the writing movement and to show what factors are prominent in the writing of both children and adults, and to show how these factors operate to make the difference between good handwriting and bad. The account given herewith is, therefore, a summary of extensive investigations, many of them of an experimental nature.

2. PSYCHOLOGY OF HANDWRITING

"*Analysis of Movements.* We may distinguish between two aspects of the writing movement. The first has to do with the composition, which refers to the character and relationship of simpler movements which make up the complex coördination. The second has to do with the nature of the changes in the speed or the rhythm of the writing. We shall first discuss the composition of the movement. . . .

"The movement may be considered from two points of view. The first concerns the side-to-side progression of the hand across the page while the letters are being formed. Experimental analysis has shown that this is one of the most important aspects

of the writing movement. Exercises will be given which are designed especially to develop this movement. In fact these are the only purely formal movement exercises in the course. When this sideward movement is not properly carried out, the hand becomes cramped and the letters cannot be easily formed. Furthermore, if it is not carried on continuously and regularly, the slant and shape of the letters are likely to be irregular.

"This sideward movement, as has already been said, is made by swinging the forearm about the elbow or the resting-place of the arm on the table. This is a movement which is very easily made alone, but it is difficult to combine with the production of the letters. The most common fault is the alternation between the writing of the letters and the progression of the hand. The difficulty comes, then, in learning to combine the two. Specific exercises are also given to facilitate this combination of sideward movement and letter formation.

"As the arm movement is adapted to carry the hand sideways across the page, so the fingers are adapted for the greater part of the formation of the letters. This is contrary to the common view, but experimental evidence shows very clearly that the arm movement is not well adapted, in the case of the great majority of persons, for the formation of the details of the letter. It is a large, comparatively slow movement, and not particularly well adapted for the production of minute forms. It requires a great deal of practice to develop, and while after it has been developed it results in smooth, regular writing, it is not suited to the majority of public school children. Careful measurements have shown that the majority of children who have been trained in its use employ it very little in their ordinary writing. Even expert writers use the finger movement to a greater or less extent.

"That the arm movement is not conducive to rapidity is shown by the fact that there is no correlation between the speed of writing and the amount of arm movement which is used. The child will naturally fall into the use of the arm to a slight degree in making the up-and-down strokes, if he develops a free sideward movement of the arm and hand. It is not necessary, however, to talk to him about this or to give exercises which are designed directly to produce it. He may be allowed to use his fingers as much as he is inclined, provided he maintains the proper position, the freedom of sideward movement, and ease of grasp.

These may be secured without the extensive and strenuous arm movement drill which is common.

"*Rhythm.* An aspect of the writing, which has not received much attention because it is difficult to observe, has been shown by experimentation to be very important. This is the organization of the movement in respect to its timing. We ordinarily refer to this aspect when we speak of the rhythm of a movement. The timing of the handwriting movement, however, is not characterized by a definite and uniform rhythm. The movement is divided into units, as in the case of a uniformly rhythmical movement, but these units are not of equal length. They are adapted to the complexity and length of the stroke which is to be made. In the early stages of the development of the movement, we use a uniform rhythm in order to give the child a start, but as the movement becomes more delicately adjusted to the requirements of the letters, the duration of each stroke becomes slightly modified.

"The rate at which the count for the exercises is given is adjusted to the ability of the pupils of successive grades. The rate which is prescribed for each grade is such that the pupil in following it will write at the standard rate for that grade.

"Some pupils will be able to adapt themselves to a faster rate when the writing in concert is abandoned in the latter part of the year, and other pupils may find it advantageous to write at a somewhat slower rhythm. These individual adjustments can be made after the pupils have become accustomed to rhythmic writing through the class exercises.

"The good writer as contrasted with the poor writer breaks the entire movement into units or strokes. These units are not separated by complete pauses, in most cases, but by a slowing down of the movement. Thus the movement proceeds by a succession of alternate flights and rests.

"A unit ordinarily corresponds to a double stroke, an upward and downward, or a downward and upward stroke. Each of these units is made with a gradual increase in speed toward the middle, and a gradual decrease toward the end. The speed decreases when the stroke changes abruptly in direction. Thus the *m* is a succession of three strokes, each composed of an upward and downward stroke. The stroke slows down somewhat on the curve at the top and is retarded more decidedly still when the

direction of the movement is sharply reversed at the bottom. The poor writer either does not slow down at the places where there is a radical change in the direction of the stroke, or he slows down at those places where it is not appropriate.

"Each of these units is made in regular fashion. If we compare the movement of a good writer upon successive units which produce similar letter forms, we find that the speed changes are always similar. The poor writer, on the other hand, is inconsistent, and may vary considerably the type of speed changes in making a succession of similar letter forms.

"The division of the writing into units is promoted by counting. The counting, however, must be done in such a way as to be suited to the letter forms which are being made. Furthermore, the child must be shown how to adapt his strokes to the counting in detail. Mere counting rapidly while the child writes along, without having learned how to apply the count to each individual letter, is of little use. . . .

"The adoption of a favorable position and the development of a movement organization into units, as has been described, will promote the development of one of the most important features of a skillful act. This is a moderate relaxation of the muscles. The muscles, of course, must have a certain amount of tension, but the tension is very commonly too great. The tension is naturally greater in the earlier stages of learning than later on, but the practice should be so directed that it may be overcome as rapidly as possible. A steady and regular succession of movements and pauses is one of the best means of promoting this desirable relaxation.

"*Principles of Practice.* Repetition. The fundamental principles of practice in learning an act of skill is repetition. Repetition, of course, may merely habituate the wrong way of performing the act, if the act is not done properly, or if the attention is not so directed as to bring about improvement. But improvement cannot take place without repetition. Discussion in handwriting lessons should be distinctly supplementary to practice by the pupil. The greater part of the writing period should therefore be spent by the pupil in actually writing. Some of this writing may consist in writing the same words or exercises over again, and some of it may consist in writing new words or exercises, but

the rule which should be remembered is that the pupil should be actually writing the greater part of the time.

"Attention on Improvement. In order that practice may be effective, the child should constantly watch the results of his efforts and strive in some definite and specific way to improve his writing. This improvement is most effectively and quickly brought about by giving attention to the form of the writing itself. We shall see that the child may profit, to some extent, by thinking of his position, or of the method of making the movement, but this is entirely subordinate to his effort to bring about some definite change in the form of the letter.

"One of the best methods of securing the pupil's attention to his writing, with sufficient attention to details to make for progress, is to have him grade his writing. The attention which he gives when he compares his writing with the scale, in order to decide what score it shall have, calls his attention to imperfections and to those parts on which improvement should be made. The more detailed the examination is, the better. For this reason a scale which has several parts, each to be applied in judging one feature of the writing, is the most helpful. Thus the child may be led to examine, first, the uniformity of slant, then the uniformity of alignment, the letter formation, the spacing, and the quality of line, in succession, and can try to improve in one specific element at a time.

"It is well to have the pupil practice continuously for some length of time upon the improvement of some specific feature. Thus he may spend a week upon uniformity, a week upon spacing, and so on. Practice which is directed to the improvement of some specific element in the writing is like shooting at a target with a rifle, while practice in which the aim is merely general improvement is like shooting with a blunderbuss, which scatters the shot widely in the hope that one of the bullets may hit the target.

"While it is important that the pupil should practise with very concentrated attention upon the improvement of the appearance of his writing, some attention may be given also to certain features of his position, and movement. We sometimes say that an act of skill is done in good form. We mean by this that the position which is assumed is the one which has been found to be

the best, and that the movement is carried out in a general way in the manner which is recognized to be the best. Thus, in serving a tennis ball, the left foot should be placed in front of the right foot. In making a golf stroke, the right hand, in right-handed players, should be placed below the left hand. While the golf stroke is being executed, the head and body should not be moved. Such general features of a movement as this can readily be observed, and can be taught by means of instruction and imitation.

"There are certain features of this sort in the writing movement which can be acquired through instruction and imitation. The hand should be held in the position which has been described above, the movement across the page should be free and easy, and the grasp of the pen should be light. Such matters as these can be emphasized by the teacher. However, the carrying out of the execution of the movement must be learned by the pupil through practice, with his attention fixed upon the result. When the result is better than he has been producing before, he knows that the movement is successful. He then repeats the movement in the attempt to secure the same success. This process of trial and success is the method by which he learns to execute a movement, after he has adopted the accepted position.

"*Emphasis on Speed and on Quality.* In directing the pupil's practice the question arises whether it is better to encourage him to aim at speed at the beginning and gradually develop accuracy of letter formation, or whether it is better to aim at a high degree of accuracy at the start and gradually increase the speed. The answer to this question differs in different kinds of learning. In those activities in which the pupil may be shown exactly how to make the movement and make it correctly from the start, a high degree of accuracy should be maintained throughout the training. This is the best method, for example, in typewriting. In this case the errors which the pupil makes retard his progress. In writing, however, it is impossible to secure much accuracy at the start and maintain anything like the desirable degree of fluency of movement. When accuracy is overemphasized, the pupil resorts to a different sort of movement from that which he will have to make later on. He in this way fails to get the feeling of the movement which corresponds to the form of the letters. He improves in such an act of skill as this

by trying more or less blindly. At first his writing is crude. If his attention is ever on improvement, however, he learns gradually, by noting when he fails and when he succeeds, to produce better and better letter forms.

"With reference to speed, two extremes in procedure are also found. One extreme is to require of the child as great or nearly as great speed at the beginning as will be expected of him in the end. This is as great a mistake as the attempt to secure extreme accuracy from the start. When the writing is too rapid, the pupil is unable to control the stroke. His letters are badly scrawled and he forms the habit of being satisfied with very poorly formed letters and words. Fluency can be secured with a movement of moderate speed, and the sacrifice in accuracy can be avoided. Many tests have shown that the general control of movement is less in the young child than in the older child or the adult. The deficient control should be recognized and the conditions made easy for the child in every way possible.

"*Automatization.* When the writing habit has been completely formed, it is automatic; that is, the writer executes without paying much attention to the position, to the details of the movement, or to the letters. The mind is then left free to give attention to the meaning of what is being written. To gain this advantage we must choose a type of movement which can be allowed to become automatic without a too excessive amount of practice. If too difficult or artificial a type of movement is taught, the child does not use it in all his writing, and it therefore does not become automatic. This is one of the chief objections of the arm movement style of writing as taught in the elementary school. In order that a movement may be automatized, the style should not be changed capriciously. Fashions in the form of letters or freakish methods of holding the pen sometimes attack a school. These should be resisted.

"A further obstacle to consistency is fatigue. When one has been performing a certain act long, he becomes tired, and without knowing why feels the desire to perform the act in a different way. This produces a kind of variation which does not produce progress, but rather breaks down the habit which is being formed. The avoidance of this fatigue is desirable and necessitates comparatively short periods. We shall consider the periods of practice in the next section.

"*Periods of Practice and Review.* For the reasons just mentioned it is necessary that the period of practice in writing should not be too long. It can of course be longer with older pupils than with younger ones, since the more accomplished we are in an act the longer we can perform it without fatigue. A comparison of the results obtained in schools where different amounts of time are given to drill in writing indicates that the progress secured with ten or fifteen minutes of practice a day is equal to that obtained with a much longer period. While the adult may secure forced improvement by intensive practice, the acquirement of the art of writing by the primary and intermediate child requires a longer stretch of time. The attempt to force it by long periods of practice does not secure corresponding returns.

"The other feature of the distribution of time is the length of time between practice periods. There has been no opportunity to compare different intervals between practice periods on a large scale. The common practice is to hold one practice period a day. The analogy with forms of learning in which different intervals have been compared would seem to indicate that one period a day is a good arrangement. If pupils require more than the ordinary practice, it is probably better to give them two periods of ten or fifteen minutes each day rather than one period of thirty minutes. In the grades up to the fifth or sixth, one period a day is in all probability better than a period every other day.

"The principle of distribution of practice applies also to the individual exercises. A particular exercise can be learned more economically by spreading the practice over several days than by concentrating it all on one day. By the distributed arrangement the pupil's interest is kept at a high pitch and he profits from the advantage of reviews. For this reason the present course utilizes the methods of short practice on each exercise in a given period and frequent review.

"What shall we set before the pupil as the aim and goal of his efforts? The common practice, of course, has been to use a copy whether in a copy-book or on copy-slips. The thing which the pupil is to aim at is the production of letters of a certain form. It has already been said that the most prominent aim in the child's mind should be the production of good letter forms. This can be done in two ways—first by setting before him ideal

forms, and, second, by leading him to examine his own writing and to distinguish between his own successful and unsuccessful attempts. Certainly the examination of the standard form should be supplemented by a very large amount of self-analysis on the part of the pupil. . . .

"*The Model of the Teacher's Writing.* In the exclusive use of a copy an element of the writing is neglected which has been found by experiment to be very important. This element has already been mentioned in discussing the speed changes of the writing movement. The movement of the pen should be organized into a series of units. This cannot all be conveyed to the pupil by simply putting before him a copy. It can be done only by showing him the actual writing process. For this reason it is necessary for the best results that the teacher should show the pupil how to write, and not merely show him a perfect copy. The case is like that of learning to handle any tool. The teacher shows the pupil how the tool is to be handled, and the pupil learns a great deal from watching the expert perform the act. The teacher should be sufficiently expert to demonstrate on the board the manner of forming the letters. The stimulus should then include the teacher in the act of writing as well as the copy. . . ."

Adaptation to Maturity. "A serious defect in many courses in writing is the failure to adapt them to the limitations and the capacity of the younger pupils. For many years the dominant handwriting methods gave almost exactly the same drill to first-grade pupils as to those in the eighth grade or in the commercial school. There has frequently been an almost total lack of adjustment to differences in natural skill and development of these younger pupils and of the older children. There has been marked increase in recent years in modifying the demands to suit these younger pupils. The grade standards which have already been given indicate that the demand should be progressively higher as we go up the grade. We must neither require so great speed nor so high a degree of accuracy in the young child as in the older one. This is an obvious adaptation to the younger child's lesser degree of control. Another way in which the burden is lightened for the younger child is by giving him materials which are easier to handle. The chalk and blackboard are much easier to use than pencil and paper, and the pencil and paper are

easier than the pen and paper. Large writing with a coarse pencil is easier than finer writing with a smaller pencil or with a hard pencil. The way in which new difficulties and higher requirements are gradually introduced is shown in detail in the plan for the succeeding grades which are given in the exercises.

"*Lower and Upper Limits of Instruction.* A special problem in the adaptation of writing to the maturity of the pupil concerns the best time for beginning and the best time for ending the teaching of writing. Some educators have believed that the child should not learn to write until the second or third grade. At the other extreme is the practice of the Montessori method which begins the practice of writing in the kindergarten period. There is no sufficient reason why writing should not begin as early as this, provided it is adapted to the capacities of the young child by the methods which have been already referred to. On the other hand, writing as it has often been taught in the primary grades is not suited to the child below the third or fourth grade. The place at which writing should begin depends altogether, then, upon the character of the writing which is taught.

"The question regarding the upper limit of instruction in writing concerns, first, the standard which should be obtained, and, secondly, the degree of efficiency of writing instruction which we should demand. It is the opinion of the writers, based upon surveys of writing of various cities, and experiments in teaching writing, that the regular writing drill which is designed to be carried on by the majority of pupils of the class should be completed in the sixth grade. By this time the pupil will have had at least three years of practice with the materials which he will use permanently. During these three years he possesses a reasonable degree of natural manual skill. He should certainly, by this time, if his training in writing has been at all consistent and effective, have laid the foundation of his handwriting habit. While it is desirable to continue to watch over his writing to keep it up to standard, he should, as a result of the natural maturing which takes place in succeeding years, be able to develop a settled habit in handwriting without specific drill.

"The case is different, of course, both with the pupils who need to write especially well to prepare for the demands of a

particular vocation and for the pupil who is naturally very deficient in manual skill. These two groups, for opposite reasons, may need continued writing drill beyond the sixth grade. It has been demonstrated, under ordinary public school conditions, however, that the large majority of the pupils can attain the final standards which have been laid down by the end of the sixth grade. It should not be necessary to prolong training in such a definite and specific habit as handwriting for more than six years. If it is necessary, the methods of teaching writing should surely be subjected to careful examination as to why they are not more efficient. We do not need to argue the point merely upon theoretical grounds. Actual experience has shown that six years is ample time in which to develop the average child's handwriting coördination. . . .

"*Individual Differences.* The general principles of learning to write have been described in the foregoing sections. These general principles apply to the practice of all individuals. In their application, however, it is necessary to allow for variations in the manner of writing to adapt it to the peculiarities of individuals. In the first place, there are differences in the nature of the writing coördination.

"Position. The position which is natural for one individual differs somewhat from the position which is natural for others. No two persons are exactly alike in the proportions and structure of the hand. If a group of persons are asked to extend the fingers, it may easily be observed that the relative length of the different fingers varies. In some, for example, the index finger is no longer than the third finger and in the others it is shorter. In some, the middle finger projects out farther from the two adjacent fingers than in others. The length of the thumb in comparison to the fingers differs in different persons. These are merely illustrations of the general fact of variation. It would be very surprising if these differences did not make desirable variations in the manner of holding the pen.

"Mode of Writing. In addition to these structural differences, there are variations in the natural mode of activity of different individuals. This may be observed, for example, in the habitual posture and manner of walking. In many cases the child's habitual posture may be observed to resemble that of one of his parents or

grandparents, indicating that it is an inherited and, therefore, natural mode of action rather than accidental. We must have due respect for these fundamental variations and must allow sufficient scope in all standard requirements to permit of their expression. In the preceding description of standard position and of the mode of writing, the statement was sufficiently broad to permit of considerable individual variation.

"The teacher should make a careful study of each child early in the development of his habit in order to assist him in adapting the general requirements to his individual needs. In doing this, care should be taken to distinguish between variations which are fundamental to the child and those which he adopts upon mere caprice. He should be encouraged, after he has found the mode of writing which suits him best, to practise consistently in this manner and thus to develop a habit which has permanence and is at the same time adapted to his needs.

"Differences in Ability. Besides these differences among individuals in the manner of writing, there are differences in ability. It is a matter of common observation that some children are naturally poor writers and others naturally good writers. These differences are found to exist in every subject of instruction which has ever been measured, and they are almost incredibly large. If we examine the scores in the speed and quality of writing of all the eighth-grade children in a school system, we shall find individuals who write more poorly than the average of the fifth grade. An idea of these individual differences may be gathered from a table which shows the results of the test in the fifth grade of a certain city.

"This is a so-called distribution table. In it each pupil is given a position according to the speed of his writing, on the one hand, and of the form or quality, on the other hand. His position in the vertical rows will be determined by the speed. Thus, if his writing is at the rate of from 60 to 69 letters a minute, he will be placed somewhere in the horizontal row to the right of those numbers which appear in the left-hand column of the table. The score in quality will determine which vertical column his record will appear in. Thus, if the score in form is 50 to 55, his tally will be placed in the column under these numbers. Each number in the table indicates the number of pupils whose writing has a particular combination of scores in form and speed. Thus we find that,

SPEED	FORM							
	Ayres scale scores							
Letters per minute	*20 & 25*	*30 & 35*	*40 & 45*	*50 & 55*	*60 & 65*	*70 & 75*	*80 & 85*	*90*
100 & above	3	4	5	2	5	1	–	–
90–99	1	4	9	6	2	–	–	–
80–89	3	10	20	29	27	14	2	–
70–79	7	16	30	31	42	8	3	–
60–69	2	22	38	32	37	12	1	–
50–59	8	13	29	32	40	12	5	1
40–49	4	5	17	14	22	11	7	–
30–39	1	1	1	2	4	1	1	–
20–29	–	–	–	1	1	–	–	–

of the pupils who write from 60 to 69 letters a minute, there were 32 whose form was graded from 50 to 55. These pupils represent the average ability in both speed and form. The pupils who are represented at the left-hand side of the table write with poor quality, those at the right-hand side with good quality. Those who are represented toward the bottom write slowly and those at the upper part rapidly. The pupils at the lower left-hand corner write poorly and slowly; those at the upper left-hand corner write poorly and rapidly. Those at the upper right-hand corner write well and rapidly; those at the lower right-hand corner well and slowly.

"We see from the table that we get nearly all combinations within the fifth grade. This tremendous variation makes the problem of teaching such a class of pupils a complex one. It is almost as though we were teaching pupils selected from several different grades. In fact, we might select pupils from the fifth and eighth grades who would be much more nearly alike in writing ability than those of an unselected fifth grade.

"Balance between Form and Speed. Many problems are raised by such a condition as this. One of them, for example, grows out of the relation between form and speed. Take the three pupils who write more rapidly than one hundred letters a minute and yet whose form is graded 25 or below. It appears that these pupils sacrifice form or quality to speed. If they wrote more slowly, it is

conceivable that they might also write considerably better. These pupils, by reducing their speed to 70 letters a minute, might be able to raise the quality to 40 or 45. A similar statement would apply to the pupils who write very slowly and very accurately. Take, for example, the one who wrote 30 to 39 letters a minute with a score in quality of 80 to 85. Such a pupil could well be encouraged to write somewhat more rapidly even at the expense of quality. The probability is that with the appropriate drill the pupil could be trained to maintain a more advantageous balance between these two elements of the writing.

"Even if we succeed in overcoming the one-sided development of the pupils who write with high speed and poor quality, or with low speed and unusually good quality, there would be widespread differences in the ability of the various pupils of a grade. These differences would be represented by the position along the diagonal line running from the lower left-hand to the upper right-hand corner of the table. If the pupils were all grouped along this line, they would all be well balanced in reference to the relation of speed and quality of their writing, but those toward the left hand would write very poorly and those toward the right hand very well. The practical question is, what should be done with the pupils who differ so from one another in their writing ability?

"Minuter Differences. While the abilities of the various pupils of an instruction group may fall within a narrow range, there will still be important differences which must be observed in the instruction of these pupils. It was said in the first paragraph on individual differences that the structure and natural type of coördination between pupils varied. As a consequence, each person has what may be called an individual style of writing, a style which is best suited to his physical and mental make-up. This style forms what is called the character of his writing. Each pupil should be allowed or even encouraged to develop a characteristic style. This style is not something to be intentionally adopted by a pupil, but is something which he falls into naturally when he writes freely, without thinking particularly about the details of his writing. It is something which comes to a pupil when his habit has become somewhat automatic and he can withdraw his attention from the details of form or movement. Investigations have shown that there is often a resemblance between the writing of

the child and that of certain of his ancestors. It is of the characteristics in which such resemblances are found that we are now speaking.

"Another somewhat more definite individual characteristic is the rhythm of the writing. The writing of some persons, like their movements in general, is rather abrupt. The individual strokes are made rapidly and with considerable pauses or changes in speed. This type of rhythm ordinarily results in an angular style of writing. The movement of other persons is more even and uniform in speed, and their writing is likely to be rounder in style. Another difference in rhythm is in the natural rate of writing. It is a matter of common observation that some persons move rapidly in general and others slowly. This difference in natural rate may be observed also in writing. While it is necessary in class exercises to use a common rhythm, this common rhythm is bound to do certain violence to both the extremely slow and the extremely rapid writers. We must, therefore, permit these extreme cases to find their own rhythm in individual practice.

"Another difference with respect to rhythm is the relative ease with which different pupils can conform to any rhythm. A careful photograph of writing movements has shown that some individuals, when asked to make a series of simple writing strokes, make them in regular rhythm, while others do not. Since rhythm is such an important element in good writing, pupils who are deficient in this aspect of the movement must receive special help. When a class exercise in making rhythmical strokes is given, it will be found that the majority of the pupils can follow the rhythm fairly easily. A few, however, will never attain it in the class exercises alone. It is necessary to give those special individual help. It may be that there are a few rare cases who are so deficient that it is hopeless to attempt to develop rhythmical movement in them. We should not despair, however, of any individuals until they have been given considerable special help.

"There are other particular elements of the writing in which individuals will need special help. Some pupils' writing will be irregular in slant and in alignment. They need to give special attention to this quality. In others the arrangement of the spacing on the page will require special attention. Some meet special difficulty in the form of particular letters and others in the smoothness and evenness of the line. Assistance should be given to each

individual pupil at the particular point where he needs it most."

[Freeman, Frank N., and Dougherty, Mary L., *How to Teach Handwriting* (Houghton Mifflin Company, Boston, 1923), pp. 13–28. By permission.]

QUESTIONS

1. Are there any of the eleven objectives listed by Ayer which are of outstanding importance?
2. In general, which is more important in determining methods, objectives or psychological principles?
3. What suggestions are given to aid in creating the desire to write well on the part of the pupil?
4. What is meant by automatization of the handwriting process?
5. Discuss the part played by critical analysis of writing in securing progress.
6. What are the various partial movements that combine to make the handwriting movement?
7. Describe the rôle of rhythm in handwriting.
8. Enumerate the principles of practice applying to handwriting.
9. What facts of individual differences should be taken into account in the teaching of handwriting?
10. Discuss the relation between form and speed in handwriting.

CHAPTER XVII

ARITHMETIC

There are interesting parallels between the acquisition of various systems of ideas by the race and by the individual learner. One such system of ideas of the utmost importance is that system which deals with numbers. Professor Judd describes many features of the probable development of these ideas during centuries of racial development, and points out the suggestions that may be obtained from this information for teaching arithmetic to the young child. It will be noticed, however, that he is careful at various points to show how different in some respects racial and individual development must be.

1. PSYCHOLOGICAL ANALYSIS OF ARITHMETIC

Number among Primitive Peoples. "Arithmetic is not a product of instinctive interests or tendencies. The individual does not develop an interest in number because of any native or inherited disposition which impels him to be exact in his thinking. In fact, all the available evidence goes to show that number is a very late product of social coöperation. Men did not count and calculate until they had reached a stage of life where property had accumulated and until intercourse between members of the social group had reached the point where exactness in thought and expression was required by the group and was imposed on the individual by the group. . . .

"There is doubtless present in all consciousness some evaluation of quantities. One recognizes the familiar objects of furniture in one's room and the members of one's family before one can count. Recognition of the primitive type here described is probably found in animals as well as in man. There is, however, a vast difference between being able on the one hand to recognize familiar groups and being able, on the other hand, to perform the elab-

orate mental act of explicitly defining the number in such a group. . . .

"The steps by which the first recognition of groups is converted into an explicit recognition of number are as follows: The observer must first discriminate the individual items which make up the group. Discrimination is an active process; it may be described as dependent on reactions in which the observer gives individual attention to each of a succession of items and makes a distinct movement corresponding to each item. The difference between the successive movements is often not great. A gesture of pointing is an individual reaction. A second gesture may be in almost the same direction as the first, but, if there is a recognizable difference in the direction of the gesture, it will serve to mark the two objects of attention as distinct from each other in location. The two gestures which are here described as means of discrimination may be extended so as to become characteristically different in respects other than spatial direction. Primitive peoples use elaborate methods of pointing in helping themselves to discriminate objects. They point first with the hand stretched out, then with one finger bent, and so on. The characteristic gestures thus developed are both aids to discrimination and means of retaining in mind the series as a whole.

The motives which a person may have for separate reactions to the members of a group of objects are often various and do not in all cases lead to counting. In practical life, some objects are discriminated because they are rejected. Active discrimination in such cases is seen to be much broader in its scope as a form of human behavior and human experience than is number consciousness. One of the most important generalizations of modern psychology is the principle that all attention and all discrimination are conditioned by reactions of some type.

"*Number as a Late Product of Abstract Thinking.* The intellectual step which must be taken in passing from the simplest and most immediate discriminating reactions to enumeration is a long one and involves as antecedent steps the evolution of language and the evolution to some extent of the power of abstract thinking. That language in general precedes the production of number names in particular is shown by the fact that semi-barbarous tribes which have very few number words have relatively large vocabularies of names for the objects which they possess. Not

only do they have words, but they are able to use these words as designations of whole classes of objects. Words help in the formation of class ideas and in this way promote abstract thinking. The foregoing statements are confirmed by the fact that the most primitive forms of enumeration consist in calling off the names of the objects which are being enumerated. Even now, when we are in full possession of a series of number names, we designate the members of the family by names, and, whenever we have occasion to find out whether all are present, we use names, not numbers. In like fashion, we sometimes call the roll of a school class or of a company of soldiers by using names. These are cases in which the interest of the enumerator in the individual members of the group is strong. . . .

"One has to think of the transition from enumeration by naming to enumeration by counting as taking place when men became interested in groups of objects—probably possessions—which were so uniform in quality and appearance that interest in the individual object receded and interest in the magnitude of the group became prominent. . . .

"There is also probably to be postulated as necessary to the evolution of a number system an element of social competition or social demand for exact communication. Men began to exchange commodities with one another and, in so doing, demanded of themselves and of those who entered into barter with them exactness of statement about the items involved.

"*Tally Systems.* As necessary devices for counting and as means of serving the interests of the social group, tally systems were evolved. The wampum of the Indians; the pebbles of the Romans; other objective facts, such as sticks or marks; and, above all, the fingers were called upon to help the minds of primitive men in being exact. Men used these tallies when they described to themselves and to those with whom they had dealings the magnitude and value of groups of objects.

"*Social Character of the Idea of Accuracy.* It is to be noted that there came into the life of man through the evolution which is being sketched a new kind of demand, born of social relationships, namely, the demand for precision and accuracy. It used to be said with complete assurance that arithmetic cultivates certain general mental attitudes. Of late, it has become the custom to deny all general training because it is assumed that belief in

general training involves acceptance of the doctrine of formal discipline in its most extreme form. The evidence derived from the experiments reported in this monograph[1] shows that school instruction may produce general ideas of addition and subtraction and, above all, general ideas of the systematic character of the Arabic number series. Indeed, we can go much further in refuting the position which has frequently been taken by those who deny general training. We can assert with a high degree of certainty that the result of all good teaching is the cultivation in the minds of pupils of broad general ideas which could not have arisen through the simplest type of perceptual recognition of objects. As soon as the mind of man developed names for classes of objects, generalized thinking began. As soon as values began to be recognized in various objects of the environment, man developed the general idea of worth and began to demand the description of this quality. General ideas represent the mature products of experience when experience has accumulated to the point where it is something more than mere recognition of objects. . . .

"Among the most important general ideas which the race has developed is the idea of exactness. Children do not have this idea any more than savages in the first stages of social life have it. In the individual, as in the race, experience has to mature and social demands have to drive the individual to the consideration of something which would not have emerged as a clear idea if there had not been social pressure for its recognition. . . .

"The evolution of number in the history of the race was very slow. Crude methods of expressing number continued to be the only instruments of trade and measurement even in historical times. The appearance of a highly perfected system capable of expressing manifold number relations and capable of being used in intricate processes of calculation is a matter of comparatively recent history. The Arabic number system came into Europe and superseded the clumsy Roman system in the sixteenth century.

"*Children's Discrimination Gradually Dominated by Social Motives.* What happened in the racial evolution of number is repeated in some of its more prominent phases in the life of the individual child. The child begins life without clear discrimination of the objects of his environment. As the child's experience progresses, certain objects are selected for specific reaction and

[1] See reference below.

for discriminative attention. Discrimination is, at first, a result of the maturing of the personal interests of the child. There is a positive response to those objects which afford comfort, and there is a specific reaction of rejection to those objects which are found to be disagreeable. Later, discrimination is guided by social, rather than personal, considerations. Some of the objects of a child's environment are vigorously brought to his attention by his elders. People themselves are so conspicuous a part of his environment and such regular sources of comfort that the child learns early in life to distinguish people from things and bestows a very large share of his attention on people and their doings. Attention is here, as in all other cases, a matter of active response. The child moves his eyes in following people about the room: he smiles in response to social example; he kicks and moves his hands and arms in delight when he is stimulated by the approach of some familiar person. From this point on, the development of the child's reactions and of his interests takes a direction which is determined in very large measure by his interest in people. He is guided by those about him. He becomes part of a social group; his interests are those which the group as a whole emphasizes. . . .

"The child in a modern civilized family finds the group interests and group reactions very highly evolved and fixed by long usage. If we think, for example, of the complex reactions which make up language, we realize how elaborate are the systems of behavior of a civilized social group. In support of his own interests and in response to the coercions of society, the child is compelled to cultivate as rapidly and as fully as he can language reactions which correspond to the accepted conventions of the group which surrounds him. His task in this case is not to invent language but to adjust himself to the social scheme. . . .

"What is true of language is emphatically true of number. The number system is a highly evolved system of social reactions which the child finds in the world into which he comes. The child's relation to the number scheme is, in many respects, different from that of the race as a whole. The race has passed through a long process of evolution, in the course of which it has produced, by exercise of its inventive genius, various systems of tallies that have served to record its gradually increasing expertness in noting quantitative facts. The race not only has evolved systems of tallies but has devoted much attention to the refinement of

the system itself. In the course of its experimentation, it has also evolved certain broad general ideas which result from the use of the number scheme. Among these general ideas is that of exactness.

The child comes into a social environment which is possessed of a highly perfected number system, but the child feels no need of it, and he is incapable of the abstract thinking that is necessary for the intelligent use of this system. To the child the number system is in itself a body of very complicated experience. He is forced to acquire the system in order to adjust himself to social demands. He finds his social environment aggressively forcing on his attention a system of names and a mode of thinking which are not at all natural to him and not of his choosing.

"When one thinks of such matters as compulsory education and the school curriculum, one realizes how aggressive society is in forcing the pupil to adopt its methods of intellectual operation. Adults know that it will be advantageous for children to learn how to think with precision. Adults know that the best system to use in order to think with precision is the system of Arabic numerals. Therefore, adults assemble children in classrooms and, by every possible means, strive to induce and compel them to adopt the Arabic numerals and all that these imply. The deliberate effort of society is to give pupils, in a few years and in its most highly perfected form, that for which the race strove during long centuries. . . .

"*Individual Methods of Mastering Number.* The psychology of arithmetic-teaching is a mixture of the psychology of the number system and the psychology of the learner. The number system is the embodiment and product of a long line of mental experiments. The number system has mature intellectual characteristics which can be described and understood. The number system has characteristics which result from the operations of the minds which produced it. It is equally true that each human being who learns the number system and uses it has a number consciousness of his own. This personal number consciousness is to be explained in part as imitating society's number system and in part as made up of the individual's own methods of thinking. If the individual's mastery of the system is quite inadequate, it often becomes necessary for society to condemn the results of number thinking which the individual reaches by his private intellectual processes. For example, if an individual believes that 7 added to 8 produces 17,

society will discipline him. If, on the other hand, the individual has certain private ways of thinking about number and using number which do not adversely affect the practical outcomes of thinking, society is tolerant and will not attempt to coerce the individual. For example, certain persons have what Galton described as 'number forms.' The number series is always pictured in the minds of such persons as arranged in a fixed spatial order. This is a matter of purely private imagery. The essential character of number ideas is not influenced in any way by this method of thinking of individual digits. The number system has been mastered by the mind in its own way, and society is not concerned to change the situation. . . .

"*General Ideas Mature Slowly.* From what has been said, it will be readily seen why time and much training are necessary in order to mature the child's development of arithmetical ideas. General ideas of what a group is and of the way in which groups can be rearranged come only through contact with many different groups. When once achieved, the higher type of thinking is continually enlarged and refined by being employed in different connections. The idea of addition, for example, is not a fixed notion. It cannot be given to a pupil. It must be acquired through a long period of enlargement of experience, in the course of which various kinds and degrees of recombination of groups are experienced.

"A very false and misleading psychological doctrine has been current in some quarters. It is said that, in the pupil's mind, addition is nothing but a long list of particular combinations. Such psychology does not provide any explanation of the general or abstract idea of addition as distinguished from particular experiences. When a teacher thinks of addition merely as a series of separate processes, he makes no provision in his teaching scheme for the operation of the generalized idea. When, on the other hand, a teacher thinks of the idea of addition as a generalized idea, he will strive to emphasize this idea. He will have confidence that, if the pupil is carried far enough to acquire an insight into the general idea, the pupil will, because of the inner drive of this general idea, help to train himself in particular cases not explicitly included in the lessons taught in the school. When once acquired, a general idea is a dynamic fact in experience. . . .

"The second truth which is to be thought of in this connection

is that, when a general idea is formulated, it reflects back on the experiences from which it was derived and gives to these experiences a new meaning and value which they could not have in a mind which has not developed the general idea. The simplest numbers have a new value for the child who has learned to add. Such a child will never use number names again without importing into them the feeling of possible grouping and regrouping. It was shown in an earlier chapter that there is progress in counting throughout the grades even though there is no explicit instruction in counting during this period. The improvement noted is part of the gradually expanding comprehension of number and of the gradually increasing familiarity with the modes of thinking that are involved in all abstract arithmetical thinking.

"*Organization the Major Fact in Mental Development.* The principles which have been enunciated in the foregoing paragraphs can be summed up in the general statement that the character of every mental process is determined by its organization, not by its isolated elements.

"It has recently been contended by the school of so-called *Gestalt* psychologists that there are no elements in consciousness. It is undoubtedly true that there are no isolated elements; there are no elements which can be detached from the mind's mode of uniting them into patterns of experience. For the student of educational psychology this means that number experiences are gradually matured through organization into higher and more general types of thinking. Group ideas are of a higher order than the process of counting; addition and subtraction are of higher order than mere grouping. With each step upward to higher levels of thought, the whole number scheme is seen by the learner in a new perspective, and each item of experience takes on a new value and meaning. . . .

"There is a final matter of general interest on which it is appropriate to comment . . . , that is, the matter of curriculum construction. Everywhere in the United States school systems are engaged in reorganizing the curriculum. There is a tendency in many quarters to think of arithmetic as one of the subjects which can be drastically reduced. It is sometimes urged that arithmetic be cut down to the point where only its practical applications will be included in the curriculum. The conclusions to which the study reported in this monograph lead are diametrically opposed to the

doctrine that arithmetic should be reduced to a few exercises in practical calculation. If the experiments which have been reported prove anything, they prove that the general ideas which are developed through contact with numbers can be cultivated in the individual only through a broad acquaintance with the properties of a highly perfected number system. To eliminate number instruction from the schools or to give it only a minor place would be to suppress one of the most significant general ideas that the race has evolved. To reduce arithmetic to a few practical applications would be to neglect the general idea of precise thinking on which our mechanical and scientific civilization rests."

Practical Skills versus Generalization. "The issue between two fundamentally different views with regard to the curriculum which are now before the school people of this country is nowhere clearer than in the sphere of number training. It is the issue between the view that the duty of the school is the cultivation of comprehensive general ideas and the view that the sole duty of the school is to train pupils in relatively trivial particular skills. There can be no doubt that powerful influences are at work in the pedagogical world to reduce all training to the cultivation of practical and particular skills. Fortunately, the mind of man is so organized that it generalizes. Even if all the curriculum-makers resolve to train nothing but particular abilities, pupils will generalize, and will continue to do what the race has done throughout its history, that is, abstract from particular situations those aspects which are most universal. Some children will acquire the general idea of mathematical exactness no matter how far curriculum-makers go in running counter to human history. . . .

"It will certainly be to the advantage of the schools if the demand for a reduction of arithmetic is met by a vigorous counter demand for a more rational understanding of the place of number in the world of ideas and of its importance to civilization. Curriculum-makers should be urged to recognize the fact that the curriculum is made for the purpose of training minds, not for the purpose of reflecting the immediate needs of practical living. There are psychological requirements which must be met in curriculum-making, and these are infinitely more important for the future of the race than are the practical adjustments of trade and industry. When the Arabic numerals came into Europe, they found many skills highly developed, but they found little

exact science. In the short span of time which is marked by the lapse of less than four centuries, the industrial revolution has substituted machines, which are products of precision in thinking, for human hands, and exact science for blind trial. The achievements of the industrial revolution would have been utterly impossible without number. It is no trivial assault on the intellectual institutions of the race that is made by those who would dispense with mathematical education or reduce it to a bare minimum. . . .

"It is unfortunately not alone in the field of arithmetic that the contention has been advanced that general ideas be eliminated from the school program. It may fall to the lot of arithmetic, which is well intrenched, to serve as the defender of the general disciplines in the school curriculum. It is not difficult to demonstrate that arithmetic depends on the cultivation of general abstract ideas as well as on practical applications, and this demonstrated relation of arithmetic to abstract thinking can certainly be appealed to as evidence that the school should not neglect general ideas. All the experiments and analyses reported in this monograph lead to the conclusion that general ideas are the most important products of instruction in arithmetic. The fundamentals of arithmetic are general ideas and general formulas, not a multitude of special skills."

[Judd, Charles Hubbard, *Psychological Analysis of the Fundamentals of Arithmetic*, Supplementary Educational Monographs, University of Chicago, XXXII (February, 1927), pp. 98–103, 105–106, 109–110, 115–117. By permission.]

Few adults have any appreciation of the great complexity of the problem that the child faces in learning arithmetic. Buswell and John have published in the monograph from which the following extract is taken an account of these difficulties as they found them to exist in extensive studies of individual children's responses in arithmetic. These paragraphs should serve to show the prospective teacher some of the difficulties that may be expected, and to emphasize the importance of individual diagnosis and treatment.

2. THE TEACHING OF ARITHMETIC

"This monograph has been concerned with the four fundamental processes, an adequate mastery of which is essential to success in arithmetic. However, a mastery of these fundamentals

alone does not guarantee ability to meet all the demands of the school or of society so far as arithmetic is concerned. After the fundamental operations have been mastered, there is still the difficulty of applying them to the solution of problems. Problem-solving is, in a very real sense, the test of one's ability in arithmetic. There need be no conflict, however, between the emphasis on the fundamentals and the emphasis on problem-solving. Both must be adequately taught. While a mastery of the fundamentals does not guarantee ability to solve problems, a lack of knowledge of the fundamentals very seriously interferes with problem-solving. Pupils frequently fail to solve problems correctly because their methods of manipulating the four fundamental processes are so clumsy that their attention is diverted from the problems to the details of the number combinations."

Individual Methods in Fundamentals. "There is a great variety of habits of work employed by children in dealing with the four fundamental operations. This fact, which has been demonstrated in the preceding chapters of this monograph, leads to the conclusion that many of these habits are the result of the child's own inventiveness, necessitated by the lack of adequate teaching on the part of the school. Left to his own devices, the child has stumbled upon many methods which are uneconomical and which might have been avoided if the teacher had understood the methods which the pupil was actually using. The failure of the school to discover the mental processes of the pupil may be charged to a method of instruction which conceives of the teaching of arithmetic in terms of drill exercises involving many examples without adequate preliminary instruction with regard to the manner in which the examples should be worked. The textbooks leave this step of explanation to the teachers, but the teachers have not been trained in the analysis of mental processes, and consequently are unable to supply the necessary guidance for the pupils. Instead, they merely follow in detail the practice materials provided in the textbook and leave the pupils to their own resources in discovering the most economical methods of working the examples.

"It is interesting to note that the ordinary text in arithmetic is not an explanatory book but a manual of examples accompanied by a minimum of explanation. If one were to examine almost any three-book series of arithmetics and cross out every example

which is to be worked by the pupils, leaving only the explanations of the processes involved in the working of the examples, the remaining material would constitute the actual teaching contribution of the textbooks examined."

Eye Movements in Adding. "The analyses of eye-movements . . . showed a variety of methods of adding columns of digits. If one examines the textbooks in arithmetic to find out how a child is instructed to add a column of figures, one will find, in many cases, the most meager directions. It is assumed by many textbook writers that the ability to make the individual number combinations is all that is required as preparation for column addition, and that, when the child has learned these combinations, he may be directed to add columns of numbers. The results of this assumption are clearly indicated in the eye-movement photographs. Many children fail entirely to get the idea that the best method of adding a column of numbers is to adopt some regular, systematic procedure. The random skipping about in the column is clear evidence that many children have thought that this is the way in which column addition should be carried on. Likewise, if one examines the textbooks to see how long division is explained, one finds not only considerable variety in the explanations given but also very real inadequacy in the explanations. Writers of textbooks have raised the objection that the necessary explanation must be given by the teacher, since, if it were included in the text, the book would be too large. It might be a worth-while experiment for a writer of textbooks in arithmetic to make a series of books which are purely explanatory and to include in special manuals of practice exercises all the materials to be used in fixing the facts which are taught. Such an experiment would at least emphasize the present inadequacy of the teaching materials as contrasted with the drill materials in textbooks."

Need of Analysis of Pupil's Mental Processes. "Obviously, whatever genuine teaching of arithmetic is done in our schools must be done by the teachers, and here is the chief issue raised by this monograph. What constitutes the teaching of arithmetic? Is the teacher really teaching who, after presenting the textbook material, simply insists that the children drill until the answers are accurate? Is the teacher actually teaching who merely explains the examples in terms of her own adult understanding of the number system? Teaching arithmetic involves an analysis of

the mental processes of the pupil who is working with the fundamental operations. The teaching of arithmetic is, in one sense, very much more difficult than is the teaching of many other subjects, simply because little explanation is given in the textbook and much is left to the teacher. Before the teacher can adequately teach her subject, she must understand the mental processes of the pupil and the complexity of the subject for the pupil. There is only one source for this information, and that is the pupil himself. There is no alternative except for the teacher to analyze the mental processes of the pupil in order to discover exactly how he carries on his work and to determine the precise difficulties which he experiences. The teacher will then be able to lay out a plan of teaching to help the pupil overcome his difficulties. Arithmetic must be taught in terms of the pupil, not simply in terms of the subject itself, and not until teachers understand intimately the nature of the difficulties which children encounter in arithmetic can the school expect very much change in the high percentage of failures in this subject."

Difficulties Encountered by Pupils. "The number scheme which the school asks the young child to master is a highly abstract system. It represents one of the outstanding intellectual achievements of the race. In most cases the teacher has mastered this number system to such an extent that its use has become practically automatic. So far as the child is concerned, the number system is difficult, highly abstract, and, in many cases, without meaning. He learns 6 plus 7 equals 13 and 7 times 12 equals 84 simply as facts which are so because the book says so. The teacher has told him that all he needs in these cases is to form a simple bond of association between the two numbers and their sum or product. It is difficult to get the teacher to understand that this system of association is simple only after it has been learned and that for the child it is a very complex scheme. Teachers might develop a much more sympathetic attitude toward the difficulties experienced by children if they would spend an hour in working with an unfamiliar number system, such as the one described in the following paragraphs.

"An example of an easy modification of the decimal grouping may be obtained by using a system based on five instead of ten and by substituting letters for numerals. If such a system were used, the numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, etc. would

be replaced by the symbols a, b, c, d, e, ba, bb, bc, bd, be, ca, cb, and cc. In such a system one finds that a takes the place of 0, that b plus c equals d, that c plus d equals ba, and that ba plus bc equals cc. The teacher should not, of course, be confused by such a system, since she is already familar with one type of number system. In this respect, her task is much more simple than is the task of the elementary-school pupil in learning the decimal system, since he lacks an understanding of the nature of any systematic number scheme. Furthermore, this system based on five is less complex and also less adequate than is the system based on ten.

"Some of the difficulties which the child encounters may be illustrated by asking the teacher to work certain simple examples with this new system. For example, when the teacher is asked to multiply bc by bd she will, if she does it properly, write the following notations:

```
  bc
  bd
  ---
  eb
 bc
 ----
 cbb
```

"As another example from the modified number system, the teacher might divide dea·bbd by cd. In this case, if the example is worked by long division, the result will appear as follows:

```
        bc·bdb
     ----------
cd ) dea·bbd
     cd
     ---
     bba
     bab
     ---
       eb
       cd
       ---
       bdb
       bce
       ---
         cd
         cd
         ---
```

"The first figure in the quotient is b. The first operation is b times cd, and the product is cd. This product subtracted from the first two figures of the dividend gives a remainder of bb. The a is then brought down. The second figure in the quotient is c; c times cd gives the product bab, which in turn is subtracted. The next number in the dividend is brought down, etc.

"These examples represent very 'simple' number operations. If the teacher is really ambitious to try the new number system further, she might find it interesting to divide a seven-place number by a five-place number, or to multiply two four-place numbers made up largely of the symbols c, d, and e.

"The writer has frequently tried such an experiment as this with college students. The most interesting result which is obtained comes from the questions which are asked by the students. These questions resemble very closely the questions which are asked by pupils in the third and fourth grades in working corresponding examples with Arabic numerals and a decimal system. The difficulties exhibited signify much more than simply a lack of knowledge of the new number combinations. The questions asked very frequently reflect confusion as to the process to be carried on. For example, such a matter as carrying or bridging the tens creates a surprising amount of difficulty for adults who attempt to use such a system of numerals.

"Such an experiment shows very clearly the fact that the number system is easy for the adult simply because it has been learned and that, in the case of children engaged in the process of learning, the number system is far from simple."

Proper Methods of Work Should Be Given Prior to Drill. "Arithmetic has become formal in terms of itself. Children in large numbers fail to master it. The remedy which the school has frequently applied is to drill more or to insist on greater accuracy. Both of these remedies may be commendable in part, but, for the child whose methods of work are clumsy and wasteful, simply giving him more drill may be to fasten upon him still more tightly habits of work which are not conducive to good results. What the school should insist upon is that the teacher *teach* more, that the teacher teach intelligently, teach purposefully, teach specifically. This kind of teaching can never be done until the teacher understands the processes by which the pupil is doing his work and the difficulties which he encounters.

"This monograph has given objective evidence of the great variety of processes used by a group of children. The teacher must now identify the mental processes used by a given pupil and teach specifically to correct those processes which are found to be inadequate. The child's work in arithmetic must be improved, not by putting a still greater load of drill on the child but rather by intelligently directing him to methods which will be productive of more accurate results. This involves a scientific analysis of how the child proceeds and a thoroughgoing attempt to devise ways of teaching the child better methods of work. This does not mean that drill in arithmetic should be abandoned, but it does mean that more emphasis should be placed on proper methods of work before drill is begun."

[Buswell, G. T., and John, Lenore, *Diagnostic Studies of Arithmetic*, Supplementary Educational Monographs, University of Chicago, XXX (1926), pp. 195–199. By permission.]

3. RELATION OF ARITHMETIC TO READING

A Test in Arithmetic Often a Test in Language. "The comment has frequently been made by those who have conducted tests in arithmetic that there is a relation between the ability of pupils to read and their ability to deal with numbers, especially when there is a demand for the solution of problems involving both the use of numbers and the reading of material in which the required manipulation of numbers is described. Thus, in 1912, Thorndike, in discussing the measurement of educational products, cites certain test problems in arithmetic and adds the comment: 'The first test is not so much in arithmetic as in language; the difficulty is in the words "already," "too," "someone," "would," "in all." '* The same author has enlarged on this statement in his later writings and has presented an analysis of textbooks showing how difficulties in language are carelessly tolerated by authors. Similar comment regarding difficulties is made by another author.

"Still another writer closes a discussion of arithmetic tests with

* Thorndike, E. L., "The Measurement of Educational Products," *The School Review*, Vol. XX, May, 1912. By permission of University of Chicago.

this statement: 'It might be well for inexperienced teachers to note this fact: that failure to solve verbal problems may be due to a lack of training in reading rather than a lack of training in numbers. It might, therefore, be advisable, at least occasionally, to use verbal problems in training pupils in technical reading.' *

"Special training in careful reading and analysis of problems was required with advantage to pupils in the case reported by Newcomb. Harlan shows that there is a parallelism in the school history of pupils between their achievement in reading and arithmetic.

"In seeming opposition to these observations are the findings of two investigators. Hackler, testing high-school pupils, finds low correlation between ability in arithmetic tests and ability in reading tests. Wilson finds in a study of silent reading that pupils make very different scores when they are subjected to tests which require ability to read problems in arithmetic from those that they make when reading geography or grammar or poetry."

Difference between Reading Numbers and Ordinary Reading. "The apparent antithesis between the two sets of findings is removed by an elaborate investigation made by Terry and reported in summary form in an article and in full in a monograph. Terry's investigation shows that when reading numerals one divides the material being read into much smaller units than when reading words. A reader very seldom apprehends more than two numerals at a time. Thus, in reading 436,287, an ordinary reader is likely to break up the material in some such way as this: 4, 36, 2, 87. The divisions made in order to facilitate recognition are not always the same. A reader who makes at one time the division given may later read the numerals by subdividing as follows: 43, 62, 87. In a few instances these numerals may be grouped by three's: 436, 287. This requires, however a wider span of recognition than is common.

"The fact that the range of recognition for numerals is so different from the range of recognition for words and letters, where as many as twelve letters can be grasped at a single glance, explains why it is that pupils are often very much confused in their reading of arithmetic problems. The textual part of an

* Dawson, Chas. D., *Some Results in Using Starch's Arithmetic Reasoning Text*, "Journal of Educational Research," Vol. II, October, 1920. By permission of Public School Publishing Company.

arithmetic problem requires one type of attention, while the numbers call for an entirely different type of memory to keep numbers in mind from that which is required to recall the logically coherent words and phrases which make up the verbal part of the problem.

"The trained adult, when confronted by the two different intellectual demands described, adjusts himself to the difficulty by reading the problem twice. The first time he reads he gives the numbers only the most casual attention, glancing at them long enough to get some idea of their general magnitude but neglecting all details. During this first reading he gets what may be called the story of the problem and discovers the arithmetical operations which are necessary in order to reach a solution. He does not close his first reading, however, with sufficient knowledge of the numbers to proceed. He therefore goes back and looks at the numbers a second time. This time he notes the exact digits of which the numbers are composed. His units of recognition are short and adapted to the numbers as distinguished from the words."

Methods of Training Pupils to Read Arithmetic Problems. "Very important lessons for the teacher issue from the analysis which Terry has made. In the first place, it becomes evident why pupils are often greatly confused in reading arithmetic problems. In the second place, it becomes equally evident that pupils must be given much opportunity to cultivate effective reading habits if they are to escape this confusion. They should be trained in the reading of numerals and also in the methods of interpreting the verbal part of arithmetic. This means attention on the part of teachers to the vocabulary of arithmetic, careful explanation of many terms which are now too often taken for granted, and attention to the grouping of numbers.

"It is probably not wise to talk to young pupils about methods of reading arithmetic problems because any discussion of this type is likely to make them unduly self-conscious. The proper differentiation of methods of reading numerals and the verbal part of arithmetic can be best cultivated by training (1) in the reading of numbers, (2) in the interpretation of the verbal part of problems, neglecting the numbers and asking the pupils to repeat the story involved, and (3) in the combining of the two types of reading in exercises that call at the same time for both types of reading.

"The work of Terry should be extended through observations on an extensive scale in the classrooms of all grades. There can be no doubt that the arithmetic reading habits of pupils involve many complexities which systematic studies would reveal to the great advantage of the schools."

[Buswell, Guy Thomas, and Judd, Charles Hubbard, *Summary of Educational Investigations Relating to Arithmetic*, Supplementary Educational Monographs, University of Chicago, XXVII, pp. 153–155. By permission.]

Professor Dewey has remarked that thinking does not go on in a vacuum. Too many teachers who are interested in training the pupil to think do not realize the necessity of providing the pupil with things to think about, and with the habits that are necessary in order to think successfully. Professor Thorndike points out the error in this kind of teaching and the psychological reasons for avoiding it. It is interesting to contrast the emphasis placed on habit by Thorndike with that placed on generalization by Judd. Superficially, there is opposition between these two writers, but each is emphasizing an important aspect of the subject.

4. REASONING AS THE COÖPERATION OF ORGANIZED HABITS

Reasoning Not a Magical Power. "The pedagogy of the past made two notable errors in practice based on two errors about the psychology of reasoning. It considered reasoning as a somewhat magical power or essence which acted to counteract and overrule the ordinary laws of habit in man; and it separated too sharply the 'understanding of principles' by reasoning from the 'mechanical' work of computation, reading problems, remembering facts and the like, done by 'mere' habit and memory."

Reasoning Dependent on Habit. "Reasoning or selective, inferential thinking is not at all opposed to, or independent of, the laws of habit, but really is their necessary result under the conditions imposed by man's nature and training. A closer examination of selective thinking will show that no principles beyond the laws of readiness, exercise, and effect are needed to explain it; that it is only an extreme case of what goes on in associative learning as described under the 'piecemeal' activity of situations and that attributing certain features of learning to mysterious faculties of

abstraction or reasoning gives no real help toward understanding or controlling them.

"It is true that man's behavior in meeting novel problems goes beyond, or even against, the habits represented by bonds leading from the gross total situations and customarily abstracted elements thereof. One of the two reasons therefor, however, is simply that the finer, subtle, preferential bonds with subtler and less often abstracted elements go beyond, and at times against, the grosser and more usual bonds. One set is as much due to exercise and effect as the other. The other reason is that in meeting novel problems the mental set or attitude is likely to be one which rejects one after another response as their unfitness to satisfy a certain desideratum appears. What remains as the apparent course of thought includes only a few of the many bonds which did operate, but which, for the most part, were unsatisfying to the ruling attitude or adjustment."

Association by Similarity. "Successful responses to novel data, associations by similarity and purposive behavior are in only apparent opposition to the fundamental laws of associative learning. Really they are beautiful examples of it. Man's successful responses to novel data—as when he argues that the diagonal on a right triangle of 796.278 mm. base and 137.294 mm. altitude will be 808.022 mm., or that Mary Jones, born this morning, will sometime die—are due to habits, notably the habits of response to certain elements or features, under the laws of piecemeal activity and assimilation.

"Nothing is less like the mysterious operations of a faculty of reasoning transcending the laws of connection-forming, than the behavior of men in response to novel situations. Let children who have hitherto confronted only such arithmetical tasks, in addition and subtraction with one- and two-place numbers and multiplication with one-place numbers, as those exemplified in the first line below, be told to do the examples shown in the second line.

Add	*Add*	*Add*	*Subt.*	*Subt.*	*Multiply*	*Multiply*	*Multiply*
8	37	35	8	37	8	9	6
5	24	68	5	24	5	7	3
–	—	23	–	—	–	–	–
		19					
		—					

Multiply	*Multiply*	*Multiply*
32	43	34
23	22	26
—	—	—

They will add the numbers, or subtract the lower from the upper number, or multiply 3×2 and 2×3, etc., getting 66, 86, and 624, or respond to the element of 'Multiply' attached to the two-place numbers by 'I can't' or 'I don't know what to do,' or the like; or, if one is a child of great ability, he may consider the 'Multiply' element and the bigness of the numbers, be reminded by those two aspects of the situation of the fact the '$\begin{smallmatrix}9\\9\\\hline\end{smallmatrix}$ multiply' gave only 81, and that '$\begin{smallmatrix}10\\10\\\hline\end{smallmatrix}$ multiply' gave only 100, or the like; and so may report an intelligent and justified 'I can't,' or reject the plan of 3×2 and 2×3, with 66, 86, and 624 for answers, as unsatisfactory. What the children will do will, in every case, be a product of the elements in the situation that are potent with them, the responses which these evoke, and the further associates which these responses in turn evoke. If the child were one of sufficient genius, he might infer the procedure to be followed as a result of his knowledge of the principles of decimal notation and the meaning of 'Multiply,' responding correctly to the 'place-value' element of each digit and adding his 6 tens and 9 tens, 20 twos and 3 thirties; but if he did thus invent the shorthand addition of a collection of twenty-three collections, each of 32 units, he would still do it by the operation of bonds, subtle but real.

"Association by similarity is, as James showed long ago, simply the tendency of an element to provoke the responses which have been bound to it. *abcde* leads to *vwxyz* because *a* has been bound to *vwxyz* by original nature, exercise, or effect."

Purposive Behavior. "Purposive behavior is the most important case of the influence of the attitude or set or adjustment of an organism in determining (1) which bonds shall act, and (2) which results shall satisfy. James early described the former fact, showing that the mechanism of habit can give the directedness or purposefulness in thought's products, provided that mechanism includes something paralleling the problem, the aim, or need, in question.

"The second fact, that the set or attitude of the man helps to determine which bonds shall satisfy, and which shall annoy, has commonly been somewhat obscured by vague assertions that the selection and retention is of what is 'in point,' or is 'the right one,' or is 'appropriate,' or the like. It is thus asserted, or at least hinted, that 'the will,' 'the voluntary attention,' 'the consciousness of the problem,' and other such entities are endowed with magic power to decide what is the 'right' or 'useful' bond and to kill off the others. The facts are that in purposive thinking and action, as everywhere else, bonds are selected and retained by the satisfyingness, and are killed off by the discomfort, which they produce; and that the potency of the man's set or attitude to make this satisfy and that annoy—to put certain conduction-units in readiness to act and others in unreadiness—is in every way as important as its potency to set certain conduction-units in actual operation.

"Reasoning is not a radically different sort of force operating against habit but the organization and coöperation of many habits, thinking facts together. Reasoning is not the negation of ordinary bonds, but the action of many of them, especially of bonds with subtle elements of the situation. Some outside power does not enter to select and criticize; the pupil's own total repertory of bonds relevant to the problem is what selects and rejects. An unsuitable idea is not killed off by some *actus purus* of intellect, but by the ideas which it itself calls up, in connection with the total set of mind of the pupil, and which show it to be inadequate."

The Hierarchy of Habits in Arithmetic. "Almost nothing in arithmetic need be taught as a matter of mere unreasoning habit or memory, nor need anything, first taught as a principle, ever become a matter of mere habit or memory. 5×4 equals 20 should not be learned as an isolated fact, nor remembered as we remember that Jones' telephone number is 648 J 2. Almost everything in arithmetic should be taught as a habit that has connections with habits already acquired and will work in an organization with other habits to come. The use of this organized hierarchy of habits to solve novel problems is reasoning."

[Thorndike, Edward L., *The Psychology of Arithmetic* (The Macmillan Company, New York, 1923), pp. 190–194. By permission.]

QUESTIONS

1. Show how primitive perception of quantity develops into recognition of number.
2. What is the relationship of language to the development of understanding of number?
3. Describe the way in which social demands for exactness arose.
4. How do children differ from the race in their development of the understanding of number relationships?
5. Discuss the importance of individual methods of mastering number.
6. Explain the statement: "The character of every mental process is determined by its organization."
7. What is the relation between knowledge of fundamentals and ability to solve problems in arithmetic?
8. In what respects are the operations suggested on p. 393 less difficult than children's operations in arithmetic? in what respects more difficult?
9. Contrast the methods of children and adults in reading arithmetical problems.
10. Discuss the relation between reasoning and habit as applied to the understanding and use of numbers.

CHAPTER XVIII

ENGLISH

The quoted passage from Professor Dewey in Chapter XI draws the distinction between the practical and social use of language and its use as a medium for thought. Language has also the function of an art. It may be a form of esthetic expression and, as such, furnishes an object of appreciation, and may be used in the cultivation of taste. The first passage of this chapter deals with the psychology of appreciation of literature, and the means for its cultivation.

1. APPRECIATION OF LITERATURE

"English courses are not merely courses in expression. They are courses in interpretation. In these courses pupils should learn to understand what they hear and read. Too often it is assumed that the understanding of language, in both its oral and its written forms, is guaranteed by elementary education. This assumption is the explanation of the fact that teachers of interpretation often struggle to find remote and difficult tasks to impose upon the pupils when they read the classics of the language. Because it is assumed that the plain meaning of the words is easy to understand, English teachers demand profound studies in grammar, etymology, and history as parts of the assignments even when pupils are reading simple narrative fiction. The fact is that not infrequently a high-school pupil needs to be trained in simple interpretation. Many a pupil cannot interpret what he hears and is very far from being a competent reader. His deficiency is a serious handicap in all his studies. . . .

"*Literature and Personal Attitudes.* The teaching of literary enjoyment is even more complicated than is the psychological explanation of the emotion of enjoyment. The teacher of liter-

ature certainly should not allow himself to be guided by the uncritical attitude toward emotions which grows out of his personal sentiments. Attitudes are individual forms of reaction and cannot be induced by teachers in the minds of pupils through any kind of formal presentation. The pupils must be induced to cultivate reactions and attitudes of their own. Instruction in literature too often deals with content only, neglecting the important item of the pupils' attitudes. . . .

"The discussion of attitudes which attach to the reading of literature may perhaps be made clearer by referring to the fact that one of the simplest phases of appreciation is that which attaches to the rhythm of a passage as distinguished from its content. If the rhythm is rapid, one type of attitude results; if the rhythm is slow, the attitude which is aroused is of a totally different type.

"*Psychology of Profanity.* Another striking example of the effect of words on one's attitude is to be seen in the feelings produced by profanity. Reference to the Deity is accompanied in the trained individual by an attitude of reverence. If this attitude is violated, as it is by an inappropriate appeal to the Deity, the listener is shocked.

"This statement should not be accepted as a vague reference to some purely theoretical experience. Reverence is a bodily attitude as well as a conscious experience. The particular attitude which any individual assumes when he is reverent is a result of his training; it is strictly individual in character, but it is always a definite form of bodily response. It may be an incipient bowing of the head, a brief holding of the breath, or some other subtle but real reaction. In contrast with this attitude of reverence, the attitude which is aroused when the sound of profanity strikes the ear is one of resentment against misplaced words. It is as real and vivid a fact as is one's recoil in the presence of an insult or resentment against an attack on one's person."

Appreciation Dependent on Understanding. "The foregoing discussion is intended to prepare the way for the statement that literary appreciation is the product of intellectual understanding and also of active response on the part of the reader. Where there is no ability to understand, there is a lack of appropriate response; where the response is absent or inappropriate, the

resultant emotion will be deficient or perverted. Verifications of these statements can be found in the ordinary experience of the English teacher. A child who has never experienced any loss or sorrow is quite unable to share in a sympathetic way the attitude of the poet who has recorded in his lines some profound human experience of distress. A concrete example is to be found in the fact that 'The Barefoot Boy' is sometimes used as a suitable reading exercise for children in the lower schools. It is assumed that, since the poem is about a boy, it will be of interest to little children. The poem is, in reality, an appeal to the experience of old age and sickness. The barefoot boy by the side of the road is not the real subject of discussion; he is merely an incident or center of comparison. The old man riding in his carriage, with all the luxuries of life around him but with ill health and physical feelings which are in sharp contrast with those of the boy, is the real center of appeal in this poem. Even the ordinary high-school youth who reads the poem has nothing in his experience which makes it possible for him to assume sympathetically the attitude of the poet.

"If the English teacher is to secure appreciation of a literary selection, he must cultivate a personal response to the situation on the part of the pupil. This personal response requires an intellectual understanding of the meaning of the selection. In addition to the intellectual understanding, there must be an emotional reaction.

"In order to illustrate the way in which emotional responses can be aroused, we may refer to a device which is an extreme example of social stimulation of emotion. It has become the convention to require all persons to stand when they hear a national anthem. The attitude of military attention which one is called on to assume when one hears 'The Star-Spangled Banner' is intended to compel the listener to take on something of the tension which the song expresses. One must understand the words, but one must also have a share in the social excitement. The full appreciation is not merely a matter of understanding; it involves also a marked degree of tension."

Incongruities in Literature. "It is evident from such considerations that the general emotional conditions of pupils will have to be considered in teaching literature. 'The Vision of Sir

Launfal' is not appropriate for study on the eve of a football game. Or, to use another example, the literary plea to be cheerful is difficult to present immediately before a school examination.

"Sometimes incongruities appear within a literary situation. A solemn warning couched in slang is unthinkable. A striking example of failure to keep the elements of a literary situation in harmony is to be found in certain hymns in which the meter is of a short and flippant sort while the ideas which are supposed to be conveyed are of a solemn type. One of the best literary critics of hymnology has pointed out that the hymn which opens with the line 'How tedious and tasteless the hours' is an example of incongruity between the tune and the ideas expressed by the words. The short, quick notes which are used are entirely out of harmony with the ideas of tediousness and despair. The discriminating observer recognizes the utter incongruity between the ideas and the rate of expression and experiences feelings either of resentment or of levity.

"*Gestures and Interpretation.* Another example of the same sort is to be found in the artificiality of many of the gestures made by amateur speakers. A gesture should carry out in some way the ideas which are being expressed. It should be free from any of the restraints that arise from the self-consciousness of the person who is making the gesture. When the ordinary pupil finds himself in a declamation contest, he is thinking more about his arms and about the spectacle which he presents to the audience than he is about the ideas which are being conveyed by the declamation. The result is that he makes gestures in a formal, rigid way, while the ideas that are expressed by the words which he is uttering call for a freedom of movement and for a type of sympathetic gesture utterly foreign to the exhibit which he is making with his own muscles. The audience sees the rigid gestures and is distracted rather than aided in following the ideas expressed.

"Where there are sincerity and complete unity of attitude in gestures and words, where the enthusiasm of the orator flows out not only in words but in spontaneous and appropriate movements of the hands and face, the total impression produced is very vivid. In such a case gestures reënforce the impression and tend to arouse in the audience a sympathetic attitude, which

is to be explained by the fact that words appreciatively heard and gestures sympathetically imitated tend to produce in each auditor bodily reactions that are in accord with those of the speaker. . . .

"It is appropriate at the close of this discussion of some of the problems which confront the teacher of English to formulate certain general psychological principles which may contribute to an understanding of the reason why the English courses in the high school are difficult to organize.

"*Lack of Analytical Attitude toward the Vernacular.* First among these is the principle that a mode of behavior which has gradually grown up through imitation is not likely to receive the type of critical attention that is accorded acts which are acquired through individual initiative. The vernacular is a striking example of a system of expression which has been acquired gradually by the individual through imitation of those about him. The result is that the pupil very seldom realizes what he is doing when he speaks. The sounds which he produces and the grammatical sequences which he formulates into sentences are dictated by imitation, not by critical choice. When the youth arrives at the high-school stage of maturity, he has a host of habits in his speech of which he is not aware. It is the function of the high school to give him a conscious control over habits which heretofore have been present but not understood. This perhaps is most impressively true where control is necessary to secure correct usage. If a pupil's habits have been acquired in an environment in which grammatical errors are tolerated, the task of the English teacher is doubly difficult. In that case the pupil must first be checked in his incorrect speech and then directed in his efforts to adopt new modes of expression. The difficulty here referred to is all too familiar to require extended illustration. In fact, the imitated modes of expression are sometimes so fixed that they persist in spite of drill in correct usage. Not infrequently a pupil who has learned correct forms reverts, especially in moments of excitement, to the crude and incorrect expressions which he used before school drill trained him in better ways. What is demanded in the way of conscious control of one's habits in a case of the type described should not lead us to overlook the fact that conscious control is desirable even in those cases where usage is correct. In such

cases conscious control can give vividness and flexibility, which cannot be acquired through imitation.

"*Special Psychological Characteristics of the English Language.* A second psychological fact which is important in American high schools is the fact that English has certain characteristics which distinguish it sharply from other languages. In the first place, it is an extremely simple language in the forms of its words. It is practically without case forms and without conjugations of its verbs. The result of this simplicity is that English-speaking pupils have difficulty with languages that have elaborate systems of declension and conjugation. Furthermore, it is difficult to bring grammatical principles to the consciousness of pupils who speak a simple language. American pupils usually get a clearer understanding of grammar from the study of a foreign language than from acquaintance with their own language."

[Judd, C. H., *Psychology of Secondary Education* (Ginn and Company, Boston, 1927), pp. 206, 217–223. By permission.]

In the passage that follows Professor Bobbitt has analyzed with great skill and insight the conditions necessary for success in learning to speak and write good English. The reader of the passage should not fail to note the application of such methods to learning in general.

2. PUPIL ACTIVITIES IN ENGLISH

"The central problem of education in the use of English is to take in hand all of the pupil's language activities and see that they are guided into proper channels. It is the language life of the pupil which must be kept of good character at all times. Two hours a week given to English composition in the high school and college has in itself relatively little relation to the matter. It is the pupil's adherence to a hundred hours of good English every week that will develop that series of language habits which constitute his ability to use English."

Language Primarily a Thing to Be Used. "Let us bear in mind that language is not primarily a thing to be taught; it is rather a thing to be used with care and watchfulness until it can be used well enough for one's general purposes. It is pri-

marily a thing to be practised, not a thing to be studied. This practice should be ten or fifteen hours a day, as one uses one's language for one's ordinary purposes. And this practice it is, and this alone, which really educates one in the use of the English language.

"Because of the subtlety of language, and therefore the elusiveness of our educational problems, let me try to make my thought clear by the use of analogies, which I think to be reasonably accurate."

Analogy of Carpenter Apprentice. "I have in mind a young man who became a carpenter. He was a high-school graduate of good average ability. In the high school he had had enough manual training to be familiar with some of the tools, the materials and the simpler processes; but he had never worked on the job. To achieve success in his calling, these are some of the things he did:

"1. As an apprentice, he worked on the job eight hours a day and six days in the week.

"2. He associated with skilled workmen, and thus lived, during all of his working hours, within an atmosphere of acceptable workmanship.

"3. For the sake of success in his calling, he had a desire to acquire the necessary skills.

"4. He observed the methods employed by skilled carpenters. These were to him the patterns for his own skill.

"5. He was of a conscientious disposition, and, therefore, always did his best. He lived up to the upper limit of his actual ability. He did not grow careless in his workmanship.

"6. He did the jobs for himself. He did not wait for others to do the work for him—not even for them to prod him into doing it.

"7. He was constantly evaluating his degree of success in achieving skilled results. He noted where his work fell short of expectations. He gave special attention to see that it did not fall short in those matters a second time.

"8. He got help from others in the evaluation of his results, and suggestions as to how to overcome any deficiencies that were noted.

"9. The outstanding activity, which must never be lost sight of, was the subjective one of always *wishing* and *willing* to do

the thing well, both for the immediate results and for the sake of achieving the skill necessary for his more remote objectives.

"He became an excellent carpenter. In other words, he became thoroughly proficient in a certain field of complex action. The fundamentals of the learning process are probably the same. Let us place the one over against the other:

"1. The carpenter learns his trade on the job. There is no other place where it can be learned. In the same way, in mastering a language, it is to be learned on the job. It is to be learned by using it the best way one can use it wherever one is using it. And there is no other place where it can be learned.

"2. The apprentice had a great desire to attain the necessary skills. In the same way in the field of language the apprentice must have a great desire to achieve facility and correctness in the use of his language. Until this desire is awakened, nothing really worth while in the matter of training can be accomplished. This is a *sine qua non* of all education. And the desire must be in the *educatee,* not merely in the educator.

"3. The apprentice workman sought in many ways to discover the patterns of good workmanship which should be employed. He carefully worked to the patterns. He was watchful against errors. He discovered mistakes and prevented a repetition of them. The successful apprentice in the field of language must likewise be diligent in searching out the patterns of good linguistic behavior and in holding to those patterns. He must be watchful against deficiencies of performance."

Education Mainly Self-Effort. "In these matters it must be noted that the apprentice, whether in the simple trade of the carpenter or in the complex field of language, must depend on himself, for his vision of the patterns, for his guidance of his activities, for his watchfulness and evaluation of the degree of success achieved, and for a constant, vigorous, and effective prevention of correction of errors. His education, in the main, must be self-effort, impelled by his desire to succeed. He cannot be mainly dependent upon foremen, teachers, schools, or any outside directive agency. The apprentice in either case needs to associate with those who provide mature example. Ofttimes he needs information which they can give, and the help of their advice, suggestion, and sometimes direction. These are, however, but auxiliary matters to assist him in the one main

thing of self-direction of his labors. The moment he relaxes and relies on others to do his watching for him, his thinking for him, his desiring for him, to uphold the standards for him, and to drive him to effort, that moment his education ceases. No person can educate any other person. Ofttimes a more mature person can provide large assistance. But it is only assistance. At bottom one becomes educated only as one educates oneself. When our profession has mastered this one fact, and when we have developed a technique which takes full cognizance of this one fact, then we shall be on the high road to an education about one hundred per cent more efficient than that of the present."

Analogy of Learning Social Conventions. "Let me change the analogy. I have in mind another young man, who joined a college fraternity. He was a freshman from a village where his social advantages had been limited. He was pretty uncertain of himself, but very anxious to live up to social expectations. He himself wanted social education; and as a consequence, he made surprising speed in accomplishing his social education. And how did he do it?

"1. To begin with, *he* did it, not somebody else for him. He did not wait for someone to do it for him, or to assign it and drive him to it. He wanted it, and so he sought it out for himself.

"2. He observed the behavior of the more mature members of his organization, with the wish to achieve the approved types of behavior.

"3. He listened to the conversation and advice of the more mature members, always wishing to achieve the levels they had achieved.

"4. He consciously imitated the patterns which he observed, always wishing to make his performance the equal of the patterns.

"5. With such attitudes of mind, with wish and will impelling and propelling him in the direction of the examples provided, naturally he unconsciously imitated the expected conventional behavior.

"6. He greatly desired; and as a consequence, he greatly tried. He watched his every step. He thought before he acted and eliminated mistakes before they were made. He sought so

to act that guidance and suggestions from his associates would never be necessary. He was managing his own education in this matter—under conditions provided by them.

"What he was doing was learning conventional social behavior in a perfectly normal way, and fundamentally in the only way in which it can ever be learned.

"Now, language is just as completely as this a kind of conventional social behavior; and in fundamentals it is to be learned in exactly the same way. In each case the learning comes from desiring—greatly desiring; from purposing, without ever any slackening of one's purposes; from observing the patterns and wishing to attain them; from being so anxious to succeed that one feels one must depend upon himself and his own efforts, and not upon teachers; from anticipating errors and eliminating them before they are made; from noting actual errors and preventing repetition of them; from doing it all as a part of life itself, and not as a part of academic procedure."

The Academic Method of Learning. "Over against this method of learning on the job, where learning can be made effective, let us contrast the usual academic method. If the young man of our illustration had tried to master the matters of conventional behavior in a purely academic way, he would have acted about as follows:

"1. He would have listened to lectures on social behavior under conditions where the type of behavior being discussed was impossible. The lectures would have been given by some learned gentleman who did not really care how the young man acted after he left the classroom, by one who was to the young man a social outsider, and to whom he was not at all socially responsive. He would have remained entirely cold to the expectations of the lecturer.

"2. He would probably have covered certain assigned readings touching upon the topics of the lectures. The readings would have been abstract and would have had no particular relation to his current day-by-day desires and problems.

"3. There might have been some classroom discussion of the problems of social behavior under the leadership of the indifferent professional outsider. The matters discussed would rarely have been related to his current day-by-day activities, and then but remotely.

"4. After all of the talk and reading, he would have taken the regurgitative type of examination, in which he would have returned his knowledge of the useless and irrelevant facts which he had, for no reason which he could see, placed in mental cold storage.

"5. The young man would not have been seeing the objectives of the class work in terms of his own personal behavior. If he should have seen such relationships, they would have been vague, general, and ineffective.

"6. He would have been passive, letting the school do the thing for him. He would not have been filled with impelling desires—doing his best, watchful against mistakes at all times, following the patterns to the best of his ability, and otherwise doing the thing for himself.

"Although too brief to be adequate, we think this is a fair characterization of the way the academic method would altogether prove its futility and its absurdity. There is certainly little resemblance in the two methods, in either the spirit or the details.

"Now, in the mastery of one's mother tongue, the familiar academic method is probably equally fantastic and futile. It omits the vital factors involved in learning the thing on the job."

Practical Conclusions. "Our practical conclusions are somewhat as follows:

"1. Let us first, above all things, find the influences to which children and youths are responsive and which can be used in awakening and maintaining their desires to perfect their English.

"2. Let us then utilize these influences in awakening a potent desire for good English, at all times, in those who are being trained. When this is done, more than half of the teaching job is accomplished. From that point onward the apprentice in English can largely find his own way, and he can find his help when he meets the places where he needs help.

"3. Let us organize the conditions of normal living by each child or youth so as to provide abundant opportunities for practising his English under conditions where he greatly desires to use it with precision and effectiveness. In other words, while in the main one must educate oneself in English, those who are assisting in guiding the processes should provide very many

of the opportunities and stimulations which will enable him to do it.

"4. We must let the pupil himself set the standards at which he will aim. The standards for him must be those which he sets up in his desires. We may wish they were higher. We may try further to awaken his desires and thus bring him to elevate his standards. But we cannot elevate them for him. We cannot impose standards upon him. It is his own desires which fix the only standards at which he will actually aim. We cannot compel the *will.*

"5. Let us depend upon and utilize this mainly self-directed use of language for ten or fifteen hours per day as the one and only thing which will accomplish his training. Let us expect other things to be of service only as they assist him in these many hours of daily practice in correct usage."

[Bobbitt, Franklin, "What Pupil Activities Should Constitute the Curriculum in English?" *Peabody Journal of Education,* Vol. III (July, 1925–May, 1926), pp. 307–312. By permission.]

The aid that language affords in thinking is a frequently discussed topic in psychology. However, it is also true that correct and worth-while speech and writing are dependent on proper methods of thought, and thought in turn is dependent on the possession of material for thinking. In a former chapter there was presented a discussion by Professor Dewey of means that may be taken for training thought through the medium of language. Professor Paul shows in the following pages that the reverse statement is also true.

3. BETTER THINKING—BETTER SPEECH

" 'All mental growth beyond a certain rudimentary stage,' says Alice Cooley, 'depends absolutely upon self expression and upon finding fitting utterance for the vague thoughts and feeling which cannot take shape or body till in language it comes to birth.' With equal truth we might add that all effective speech depends not simply upon a mastery of words and a facility in marshalling them but far more fundamentally upon a clean, clear, vital perception of the million and one things that make up the world about us, and upon the further ability to

grasp their import and significance. All too frequently teachers have failed to stress the obvious truth that to speak well one must utter something worth hearing; they have so concerned themselves with the *manner* of speech that they have slighted the *matter*. Just how we may avoid this danger, and how, to some extent at least, we may aid our pupils in gaining a wider and firmer command of clear, valuable ideas [is a problem] so vital for effective speech that it demands still further consideration.

"*The Railways of the Senses.* Obviously we must begin our task by recognizing that the ability to think depends primarily upon the number and the quality of those impressions which are brought to the mind along the railways of the various senses. Through the sensory nerves which have their receiving stations in the eye, ear, tongue, nose, and muscles of our bodies we gain our impressions of the manifold objects making up our world. As these various senses are called into greater and greater use, we come to recognize with keener and ever keener appreciation the nature of their messages, until those who cultivate long and faithfully any one of these senses, as does for example the tea tester, seem to their less educated fellows to work marvels. The Indian so trained eye and ear to catch sounds and sights that the snapping of a twig or the gleam of a far distant fire, imperceptible to the less acute senses of the white, seldom escaped him. Such a man as John Ruskin owed his mental superiority to the majority of mankind, in part at least, to the fact that he had deliberately and painstakingly schooled his senses, particularly his vision, to bear clear-cut definite messages from the world to him, to supply him with an abundance of vivid images. His mind was like a great, well equipped radio station which receives frequent and accurate news of what is doing in the world and thus possesses much valuable material which may be turned to good use. People differ markedly in their sensibility to these impressions; a few are as finely responsive as a delicate thermometer which registers a variation of a fraction of a degree in temperature; others, however, resemble those thermometers given away to advertise Dr. Quack's Cureall, which are quite indifferent to a change of five or ten degrees.

"Time spent in sharpening our senses is time well invested for securing that clearer and finer thinking which brings as

one of its chief advantages more and better materials for speech. Thus pupils should learn to distinguish more accurately and to name the various shades of color. Nature runs riot in the greens of the spring, in the gorgeous paintings of the autumn woods and skies, and even in the diverse tintings of a gray, rainy day. The 'checkered shade' cast by the summer foliage, the outlines of the bare trees mezzotinted on the snow by the winter moon, the charm of light and shadow which we may discover stamped any bright day on our ordinary cement walks, a charm incidentally, which also forms no small part of the stock in trade of our painters of interior scenes, all these contribute to a world of beauty to which many of us are blind. Here the art work of our schools has done a great deal to sharpen the sight of our pupils, but most of us are still unobservant of even such obvious phenomena as those of perspective, and that, too, when we have it before us in such striking illustrations as the apparent size of a near-by train of railway cars. Nor are we much more appreciative of distances, as was well illustrated recently when a class of college students estimated the height of a familiar room all the way from ten to thirty feet and its length and breadth with equally startling divergence.

"Similarly, most of us are quite unfamiliar with our own voices and know nothing of our pitch, our rate of speed, or even the glaring defects of our speech. What a revelation when we listen to a dictaphone repeating the words of our mouths! Can that harsh, grating tone be mine? Is my voice as mumbling and as butter-mouthed as the record represents it? Am I as slovenly and inaccurate of speech as that fellow talking from the box would have me believe? After we have asked ourselves these and other similar questions, we may well consider how accurately we can catch and revive the tones of the comedian who chuckles at us from the talking machine, whether we can distinguish and reproduce the elements in his drawl, whether our ears are sharp enough to record his other tricks of speech and our vocal organs are able to imitate these. How do our associates talk? Just what are the elements which enable us to identify a voice heard over the telephone? Of course some of these qualities are too subtle to find easy expression in words; but we may here work wonders if we will but 'awake our senses that they may the better judge.' In this connection one special pleasure must not

pass unmentioned, namely, the joy of recognizing the notes of the various members of the feathered orchestra which holds for us its annual series of concerts. 'Past a tree on which is perched a thrush simply delirious with songs,' says one keen-eared lover of nature, 'go scores and scores of people utterly deaf to the charm of "that fine fleeting rapture" '; and many another equally striking illustration might be cited of those who have ears and hear not.

"To most of our minds the railways of taste and smell bear far less freight than do those of sight and sound; nevertheless they afford valuable means of gaining a better acquaintance with this wonder world of ours and are quite capable of a marvelous development. The sense of touch, with its 'feel' of materials beneath our fingers, its lessons of harshness and softness of substances, of heat and of cold, that handling of earth or of tools and gear which provided no small part of the training of most American boys of a generation ago when the population was more largely rural, and the loss of which is but partly recompensed for the city lad by his work in manual training, that sense of touch, be it repeated, may also add immensely to the stock of experience which forms the first great requisite of thinking.

"Again, according to present-day psychologists, each of our muscles with its sensory apparatus, akin to that of the eye or the ear, will tell us much if we will but listen. Consequently, we shall do better thinking if we lead an active life and train our muscles to function at their best. How intimately good thinking is dependent upon fit muscles is strikingly brought home to each of us when in a severe illness these grow flabby, and we lose the desire and the power to think hard and well.

"*The Storehouse of Memory.* Of this flood of experiences which the senses thus keep pouring into the mind many are quickly forgotten, but many others are retained in our memories, there either to reappear at call or of themselves to force their way back to our attention. Probably we shall be nearer the truth when we say that each of us possesses not a memory but a set of memories, for these sensations retain a place in our minds largely as they associate themselves with their fellows; and indeed they may be linked to each other in diverse and curious fashions. Frequently they are joined in the association of time,

as when what happened at this hour to-day suggests what occurred at this same hour yesterday; again, it may be a relation of space, or of likeness or difference; now it is relationships close and firmly knit and now surprisingly capricious and fantastical. Whatever the way, the particular memory or set of memories is roused by a call along some track of association; the more numerous these pathways, and the deeper and broader they are, the easier and the more frequent the recurrence of the memory. Usually, if we observe carefully with a distinct purpose of telling of the experience, we shall find that this memory will be stronger and clearer."

Utilizing the Store of Experiences. "Of these materials thus entering along the paths of sensation and stored in the memory, the mind makes many and varied uses. Thus, after accumulating in memory a store of experiences, the mind employs these in apprehending and recognizing and interpreting the incoming sensation; and so thoroughly do these recollections of former experiences influence our reception of the newcomer that, as Wordsworth puts it, we live in a world which we half perceive and half create. For example, let a group of people be shown some unfamiliar object, such as a block of wood pierced at regular intervals by long, sharp nails, and then let them be asked the purpose of this contrivance; they will give widely divergent answers, depending naturally upon their former experiences.

"Constantly the mind is making a more or less strenuous and heroic effort to arrange and put into place these new impressions as they are delivered by the senses. It takes cognizance of the likenesses and differences between the newcomer and former experiences; it compares this with that and discovers that the two possess a number of common qualities but that they are also stamped with marked divergences. Observing that various likenesses seem to hold true and constant, that certain causes seem to lead to uniform results, the mind begins to generalize and to formulate these results. It selects its bundle of convictions and prejudices. Now it shapes, more or less consciously, its definitions, which are simply statements of classification indicating first those great likenesses which bind the thing defined to others of some group and then those differences which distinguish it from these. Indeed, one might almost be justified in saying that the thinking process consists in detecting these

relationships of ideas, and then synthesizing the results of these analyses. Such, we observe, is the method by which we reason by analogy, by which we explain causes and predict results, by which we exercise our imaginations. This imagination, as its name indicates, is simply our image-building faculty. Our wildest flights of fancy are but some whimsical recombination of usually easily recognizable perceptions, while the imagination displayed in planning a skyscraper or in devising a great business corporation is but another combination of perceptions, this latter, however, being a severely logical process which takes cognizance of all the various relations involved.

"*Better Materials—Better Speech.* What, now, is the connection between all this and more effective speech? The answer is not far to seek. Mother Nature has wisely contrived it so that during his earlier years the child is keenly responsive to these various stimuli borne in on the railways of his senses. If his interests are transient, they are certainly as keen and quick as they are manifold. For a time the little fellow becomes a walking question mark, a challenger and investigator of whatever falls within his ken, a tireless mental traveler in the world of marvelous adventure which is his inheritance. It is at once the teacher's duty and opportunity to foster this keen observation, to help the child establish vital contacts with the world and thus to maintain this eager zest in life, to prevent the years padding him around with inattention and stupidity. These God-given senses must be trained to bear a never diminishing freight of increasingly fine materials.

"These temporary interests with which the child is endowed must be trained, let us repeat, so that while they may lose nothing of their intensity, they may become more steadfast and permanent. Interest grows with what it feeds upon; knowledge and interest advance with nearly equal pace; the more of a subject we know, the more we wish to know. When an idea once gains the center of interest, or the focus of consciousness as it is sometimes called, it tries to summon in its related ideas; as the subject develops, as ideas continue to call in their relatives, they not only hold this center but increase immensely their chances of recall. Whenever a subject ceases to develop, it is deposed from its throne at the center of consciousness and some one of the others which are constantly knocking at the door

takes its place, there to be accorded similar treatment. It is for us, then, to guide the pupil in relating his experiences into well knit bodies of knowledge, in acquiring a competence of these better interests which shall respond quickly and eagerly to the excellent things which life has to offer him."

[Paul, H. G., *Better Everyday English* (Lyons & Carnahan, Chicago, 1924), pp. 249–255. By permission.]

Grammar as a means of promoting the use of correct speech and writing is much less in evidence in our schools to-day than a generation ago. It cannot be doubted that there is no guarantee that the teaching of grammar will function efficiently in producing correct usage. Many of the charges brought against the ineffectiveness of grammar in relation to expression are, however, in reality charges against the inefficiency of the methods used in teaching grammar. There will be no use made of grammar if no grammar has been learned. Cross suggests some psychological principles that may be utilized in making grammar significant for the learner.

4. GRAMMAR AND THE LAWS OF LEARNING

"When a speech habit is to be established, the thing to be learned must first be put into a form which will evoke satisfaction in the learner. Annoyance must be avoided except the annoyance which will be associated with failure to learn. The pupils must be aroused to an active interest in the problem before them. None need hope to learn by inactive absorption."

The Rôle of Satisfaction. "A state of readiness to learn on the part of the pupils is the first necessity. Any piece of grammar that is obviously useless can contribute very little satisfaction to a learner. External rewards for the learning of useless things may in part overcome the natural repugnance to that kind of exercise. Or the anticipation of greater annoyance at not learning than would come from the learning may induce some pupils to go through with a useless and unprofitable piece of business. For example, most modern teachers are convinced that there is no particular value to learning by memory all the various forms and verb phrases of *to be* and *to love* that were once printed in the grammars to show all the forms possible for the modes, voices, tenses, persons, and numbers. Pupils may

be in an active state of readiness to learn, but when they know how useless that memorizing is, they will develop a feeling of annoyance, producing unreadiness to learn. Readiness may again be induced by a promise of a half-holiday and a camp supper by the lake as soon as those six pages are memorized; or a willingness to make the effort to memorize them may be aroused by a threat of 'keeping in' till the work is done. The latter is a case of willingness to learn induced by a prospect of greater annoyance at not learning than would result from the less annoying effort of learning useless material.

"The topics of the grammar should, therefore, be gone through with care and those that are useless, and disagreeable because they are useless, eliminated. The usefulness of each of the topics retained should be made clear to the children. . . .

"Suppose the topic for a lesson is the double negative. What satisfaction can be attached to learning to use but one negative, to avoiding 'Nobody never told me nothing about it,' and the like? In the first place it is a satisfaction to speak like those whom one looks up to and patterns after. Who uses the double negative? Only those whose misfortune it has been not to learn any better, the uneducated. Refined, educated people say 'Nobody has ever told me anything about it.' One kind of satisfaction comes from avoiding whatever is dissatisfying, embarrassing, and annoying. To continue to use the double negative after one has become aware that only the uneducated person uses it would be embarrassing. Imagine now that the children are in a state of mental activity, not mentally inert, and that to learn to use but a single negative in a sentence and to avoid the embarrassment of the crude double or triple negative had become satisfying. What next?"

The Familiar Path. "Remember that it is the familiar path that is automatically chosen. You start out for that walk. It was a pleasant experience yesterday, has been so for the past ten days. If you had found it monotonous or had had disagreeable company the last two or three times you took it, you would pause when you came to the three possible ways to go. But it was pleasant, and you were always in good company when traveling it; so now without hesitation and without consciously choosing it you take the turn to the left. You have applied the Law of Use and Frequency, and you have found the effect

satisfying. The child who has over and over taken the single negative path will automatically turn into it and will find himself in the company of educated people.

"But suppose that Mary has always said, 'Nobody never told me nothing about it.' She goes with the teacher down the single negative path every day for a week. Then the two begin other explorations. They try the road to 'these books' and 'those books' instead of the old path of the uneducated crowd to 'them books,' forgetting all about the single negative for a time. After ten days Mary, strolling alone, comes to the divided way. Off her guard she automatically chooses, 'Nobody never.' The synapse between the new 'nobody ever' had been pulled apart in the ten days; and the old, intimate relation between *nobody* and *never* had again asserted itself.

The Place of Drill. "This means that new habits cannot be exchanged for old by satisfaction and a simple agreement to the exchange. The new bond must be so made that it will supersede the old. Then it must be practised, reviewed, and regularly used until the old habit is gone, until there is no bond to perpetuate the old habit. That, of course, is easy to say and hard to do. One who has habitually said 'ain't got no' all through his boyhood and has learned in high school to say 'hasn't any' may think that there is no bond left between the idea of being without a thing, and the words 'ain't got no.' But one day when he is speaking under some mental strain or embarrassment, when his attention is absorbed by the situation rather than fixed upon his language, the old bond will assert itself and he will say 'ain't go no.' Some one has said that a child ought to be very careful in the selection of his grandparents if he wants to have a fine mind. The same will apply to good language. The child whose parents and grandparents have always spoken good English has a great advantage over one who has been obliged to overcome bad language habits after reaching the junior high school age."

[Cross, E. A., *Fundamentals in English* (The Macmillan Company, New York, 1926), pp. 468–472. By permission.]

QUESTIONS

1. How does the psychology of attitudes apply to the cultivation of appreciation of literature?

2. How does use of English illustrate the importance of conscious control of habits?
3. Why do pupils get a clearer understanding of grammar from the study of foreign languages than from the study of English?
4. Explain the statement: Language is not primarily a thing to be taught.
5. Show the relation of desire and purpose to training in good English habits.
6. How does imitation function in the formation of habits of language expression?
7. What does Bobbitt mean by an "academic" method of training? What vital factors are omitted from such a method?
8. In what ways is "better speech" dependent on the use of the senses?
9. Explain the statement: We live in a world which we half perceive, and half create. Is it a correct statement?
10. Discuss the relation of interest to better speech.
11. Apply the laws of learning to the learning of grammar in such a way that it will be effective in correct speech and writing.

CHAPTER XIX

FOREIGN LANGUAGES

Present-day curricula and methods are largely the result of traditions going back in most cases to the practices of European education. Professor O'Shea shows that American conditions as to the need and opportunities for learning foreign languages are quite different from those obtaining among European peoples, and that, therefore, both the purposes and the methods of instruction in foreign languages should be modified to meet existing conditions.

1. THE READING OF MODERN FOREIGN LANGUAGES

"*The Foreign Language Situation in America as Compared with Other Countries.* It is a matter of common knowledge, of course, that European peoples live so closely together and are so intimately associated in commercial and social activities that it is of advantage to each and all of them to be able to speak and to read other languages than the native tongue. Consequently, there is an effective stimulus constantly and insistently operating to encourage an English, Spanish, French, German, Russian, or Austrian student to gain such a mastery of modern foreign languages that he can use them practically in his daily activities. According to the writer's observations European peoples are eager to acquire a speaking and reading knowledge of foreign languages; a Frenchman, German, Spaniard, or Italian would rather converse in English than in his native tongue with an Englishman or an American. From the moment the typical European becomes aware of the social and commercial conditions in the environment to which he must adjust himself, he has it impressed upon him that it will be of service to him to know how to speak and to read foreign tongues and to be able to understand them when he hears them. In school,

the European pupil is in an eager, receptive attitude when he is pursuing a foreign language. The people around him are using foreign languages, and he inherits the tradition that a person is not educated unless he has mastered at least one language besides his native tongue. Further, the methods employed in teaching foreign languages in France, Germany, and other European countries have been determined by the necessity of helping young people to gain command of these languages as completely and speedily as possible. The teacher of foreign languages in European countries feels a constant incentive to teach them in a dynamic way so that they can be used.

"The situation in our country is very different. Our pupils inherit the tradition, more or less clearly and definitely transmitted to them, that a foreign language cannot be of much service to them. When they visit a European country, the natives they come in contact with in the hotels and shops can speak English, so that an American in Europe can get along quite comfortably and can see and do everything he wishes without much difficulty, even if he does not know a word of any foreign tongue. Again, the Europeans who come to our country do not stimulate our young people very greatly to master a foreign language. If they are educated Frenchmen, Germans, Russians, or Italians they can and they do use our language, so that we do not feel the need to master their several tongues. If they are immigrants, our pupils do not see why we should wish to employ the language they use. The present writer has heard students ridicule the immigrants with whom they have come in contact; and unfortunately, our young people do not often meet the better-educated representatives of foreign countries whom they might admire for their intellectual and personal qualities.

"It will doubtless be granted without argument that the chief use to which our people can put foreign languages is to read them in the original for purposes of research, travel, personal enjoyment, and the pursuit of business. The movement which is gaining great momentum in America to encourage and even to compel all foreign people who take up their abode in our country to learn English is making it unnecessary for us to speak any foreign language or to understand it when spoken so far as our needs while at home are concerned; and when we go abroad we will rarely be placed in a situation in which English will not be

understood. So we cannot deeply impress our young people with the claim that they will be handicapped in daily life if they cannot speak a foreign tongue; but it should be possible to make them appreciate that they could extend their knowledge and increase their personal enjoyment if they could read modern foreign languages. It seems clear, then, that in the teaching of these languages in America, the principal objective should be to train our pupils so that they can read them understandingly, appreciatively, and readily.

"Can we teach modern foreign languages in America so that they will be read more generally than they are now? During the past 10 or 15 years, there has been a vast amount of experimentation in our country for the purpose of determining how a child can best learn to read in the native tongue. It has been shown that certain methods of teaching, once generally practised, are comparatively wasteful and ineffective, and these methods are being abandoned in all progressive schools throughout the country. Unfortunately, we do not yet have access to any important experimental data relating to the problem of teaching children to read a foreign language, so that we cannot say with finality how a pupil can best gain a mastery of the language so that he can read it understandingly, appreciatively, and readily. The present writer has no intention to impose his own opinions of this matter upon the reader, and especially upon those who give instruction in foreign languages in high school or in college; but he would shirk his responsibility if he did not offer a few suggestions based upon the psychology of learning to read in one's native language—there are several well-established principles which probably apply equally well to learning to read in a foreign language and in the native tongue."

Reading and Grammatical Diagnosis Contrasted. "The first principle that teachers of foreign languages should take account of is that reading and grammatical diagnosis are psychologically contrasted and antagonistic processes. Reading may be called—using popular terms—a synthetic mental process, while grammatical diagnosis is an analytical process. In order that a pupil may learn to read readily and with understanding and appreciation, words must function merely as symbols, and not as objects of explicit attention in and for themselves. Further, individual words cannot, as a rule, function independently; groups of

words must function as unities; meaning is usually denoted by phrases, clauses, sentences, or paragraphs, rather than by words in isolation. If the reader, then, is made verbal-minded, in the sense that he is habitually explicitly aware of each and every word in the reading material, he is retarded or slowed down in the reading process, and his understanding and appreciation of the content of his reading are interfered with. In order that he may read easily and with understanding and appreciation, he must grasp groups of words as unities, and these groups must function marginally and not focally in his attention.

"How can a group of words be made to function as a unit and marginally in the reading process? Only by repeated use of the group as a unity, with attention focused primarily upon meaning rather than upon the anatomy of the words or their grammatical relation. This will seem quite familiar to those who have kept in touch with recent experimental work upon reading in the native tongue, but possibly teachers of modern foreign languages may not have been able to study the results of these investigations with a view to determining whether the principles involved could and should be followed in the teaching of pupils to read in a foreign language.

"There is a closely related principle pertaining to learning to read easily, understandingly, and appreciatively in the native tongue which perhaps should be taken account of by teachers of modern foreign languages. A reader may gain the meaning of a phrase accurately, especially when it appears in a context so that it contains only one element of a large whole of meaning, without being able to analyze the grammatical structure of the phrase or even to give the meaning of the separate words in the phrase. It has been shown beyond question that when a child is taught to read mainly accordingly to the so-called 'silent' method, he is frequently able to give quite accurately the meaning of a paragraph, whereas he may become confused when he is required to make a minute verbal and grammatical analysis of the paragraph. It is not the wish of the writer to push this point too far, but it is desired to draw the attention of teachers of modern foreign languages to this principle as of fundamental importance in teaching American pupils so that they can read foreign tongues understandingly, appreciatively, and easily.

"It is probable that a pupil in America could learn to read a foreign language so as to derive meaning accurately without spending so much time and energy as pupils have been doing upon verbal minutiæ, particularly upon grammatical relations. Would it violate the traditional proprieties in the teaching of a modern foreign language if pupils were not required to become familiar with grammatical details, provided that they could grasp the meaning in large verbal unities? Would it be permissible to lay emphasis, almost from the beginning of the study of a foreign language, upon reading for understanding and enjoyment rather than for technical verbal and grammatical knowledge? What would an American pupil lose if he should be required to read five or even ten times as much material in a modern foreign language as has been the practice heretofore in a two-year course in high school or in college, even if he were not able to analyze accurately all the grammatical relations involved in his reading? Would his ability to read rapidly in order to gain content be more than an offset for his paucity of knowledge of grammatical details? These questions are asked respectfully of the teachers of modern foreign languages; the writer does not insist upon his own opinion in regard to the matters involved."

Composition as Related to Reading. "There seems to be a widespread belief among the laity, as well as among teachers, that a detailed acquaintance with the technical construction of a language, so that it can be written correctly, is essential to the intelligent interpretation or use of the language; but the principle seems clear that when a novice is trying to gain a reading mastery of a language he ought not to be impeded by any technical matters which are not absolutely essential to the gaining of content readily, understandingly, and appreciatively. He should acquire the habit of driving ahead in his reading instead of being retarded in order to analyze grammatical details, with the result that he cannot make rapid progress forward because he is preoccupied with details inward. It is advisable for a novice early to gain the sense that he can move forward readily and surmount linguistic difficulties easily. It is probable that the chief reason why such a large proportion of our correspondents have read no material in any language since graduation is that they had ac-

quired reading habits which did not yield easy mastery of the language for the purpose of gaining content readily, understandingly, and appreciatively.

"Experimental data relating to the acquisition of a reading mastery of the native tongue lead to the belief that it is psychologically and linguistically not true that explicit knowledge of the technical construction of a language so that it can be written correctly is necessary for a reading mastery of the language. Exactly the contrary appears to be true. It has been shown beyond question, in respect to the native tongue, that explicit awareness of technical details is a barrier to a reading mastery of the language, since, as already pointed out, reading is a synthetic process in which words must function marginally and merely as symbols to revive content; and the gaining of content is not dependent upon a knowledge of technical minutiæ in linguistic construction. In acquiring a reading mastery of the native tongue the child gains his reading habits very largely, and often completely, before he undertakes a detailed study of the technical construction of the language. Fortunately his reading habits become so settled before his technical study begins that they are resistant to disturbance from technical study. If the child were detained in the acquisition of reading until he began the study of grammar and had exercises in composition, he would be seriously handicapped in his mastery of the art of arts so that he could read easily, appreciatively, and understandingly.

"We do not, at this moment, have experimental data which enable us to say positively and finally that the psychological processes involved in gaining a reading mastery of the native tongue apply without modification to the mastery of reading in modern foreign languages; but it is probable that there is no important difference between the two. If this is a correct assumption, it follows therefrom that if the principal objective in teaching modern foreign languages in America should be the acquisition of facility in reading, then it would be advisable to delay training in composition until after reading habits have become fairly well established, so that the pupil will not become or continue to be technique-minded in reading a foreign language. Composition requires explicit awareness of every technical detail involved in the construction of sentences; the grammatical

patterns in the various types of construction must be reproduced precisely. Of course, a pupil might by repeated experience reach the point where much of the technical detail involved in composition would function marginally; but it will undoubtedly be granted by all readers that very few if any of the pupils trained in our American high schools or colleges ever attain such facility in composition in a foreign tongue that grammatical details function automatically.

"It is not intended to convey the impression that the writer advises that composition in foreign tongues should not be taught in our high schools and colleges; but it is urged that modern foreign-language teachers should consider the desirability of establishing good reading habits before composition is begun. In making this suggestion it is not overlooked that some of our correspondents have said that they have been placed in situations since graduation from high school and college in which they have felt the need for facility in corresponding in French, German, or Spanish. A considerable per cent of our correspondents in all the high-school and college groups, and in both high school and college combined, have stated that it would be of help to them if they could employ foreign languages in their correspondence. Facility in correspondence requires, of course, a reading as well as a written mastery of a language; so that if our American youth could be trained to read a foreign language easily and understandingly they would be enabled thereby to carry on their correspondence activities more effectively than if their reading knowledge of the language is so imperfect that they cannot depend upon it in an emergency. Would it not be possible, and also desirable, to train our pupils in correspondence rather than in literary composition? Our correspondents complain that they cannot communicate with business associates in a foreign language; but they have all studied literary composition in foreign-language courses in high school and college. Evidently literary composition will not function well in business situations. It would be a relatively simple matter to train a pupil in a mastery of correspondence forms; business writing is a quite different thing from literary composition in any foreign language, or in the native tongue for that matter. . . ."

Conversation as Related to Reading. "Some of our correspondents say that they have been placed in situations where a conver-

sational mastery of a modern foreign language would have been of service to them, and the question arises: Would it be advisable to require pupils to gain a conversational and reading mastery of a foreign language at the same time? Fortunately, conversation does not require as explicit awareness of grammatical detail as composition does, and so it would not probably interfere with the acquisition of a reading mastery of a foreign language, even if the two should be acquired *pari passu*. Of course, in learning his native tongue, a child acquires conversational habits normally long before he undertakes reading; but in the mastery of foreign languages it is apparently the custom in most places to begin conversation and reading on the same day and to carry them on parallel throughout the entire period of language study. It may be suggested to teachers of foreign languages that it might be better to initiate the pupil into the conversational aspects of a foreign language before attacking reading, so that he could gain some degree of automatic control of the oral form before attempting mastery of the visual form of the language.

"If conversation and reading are begun at the same time and carried on parallel throughout a course of study, then would it not be desirable to treat conversation as it has been advised that reading should be treated, namely, to develop a sense of ease in the use of the language, even to the neglect of accuracy in phonic or grammatical minutiæ? The present writer is not at all sure of his ground here. It does not seem wise to suggest that, in teaching American youth conversation in a foreign tongue, inaccuracy in respect to phonic or grammatical minutiæ should be tolerated; but still, if our chief aim should be to develop a reading mastery of a language and if training in reading and in conversation must be carried on at the same time, then in order not to have conversation retard the mastery of reading, it may be better to sacrifice conversational accuracy in respect to details than to prevent the acquisition of efficient reading habits."

[M. V. O'Shea, "The Reading of Modern Foreign Languages," United States Bureau of Education, Bulletin No. 16, 1927, pp. 72–78. By permission.]

Professor Buswell has reported in the monograph from which this extract has been taken the results of extensive investigations of the eye movements of pupils in reading foreign languages. In general he has found that many pupils do actually learn to read

French and German, but that learning to read Latin is practically unknown except at the graduate level of instruction. Professor Buswell's results seem to indicate that translation and analytical methods are opposed to learning to read foreign languages with facility, just as analogous methods are opposed to the learning of the silent reading habit in the vernacular.

2. LABORATORY STUDY OF READING FOREIGN LANGUAGES

"(1) Judging from the maturity of a student's fundamental reading habits which result from two years' study of French, there is no notable difference between students who begin the study of the language in high school and students who begin at the college level. On the same basis of judgment, children who begin the language in the elementary grades fall very much below the level of maturity of the high-school and college students at the end of two years.

"(2) The method of teaching a foreign language has a striking effect upon the reading habits of students. The maturity in reading which results from two years of study is decidedly greater with students taught by a direct method than with students taught by an indirect translation method.

"(3) During equal periods of time, approximately equal degrees of maturity are reached in the study of French, German, and Spanish when these languages are taught by similar methods and under similar conditions.

"(4) In no case did the median student in a second-year group approach closely the maturity of reading habits exhibited by the expert group of readers.

"Each of these four conclusions may be subjected to further analysis and interpretation.

"*Effect of Age.* In comparing students from elementary school, high school, and college, certain factors other than age must be considered. The median group intelligence quotients for the six groups of students concerned varied from 114 to 124, exhibiting a range of ten points. The highest median was for the second-year elementary-school group, while the lowest was for the second-year high-school group. However, considering the fact that the intelligence quotients were derived through group tests and considering further the range of chronological ages, the

differences in the medians are not significant. All groups would be classified as superior groups. A factor of greater importance in this case is the unequal degree of mental maturity displayed by the different groups. The elementary pupils were equally bright but by no means equally mature in mental development. From the standpoint of the degree of mental maturity represented, the results attained by the elementary pupils might be considered satisfactory. This precipitates the administrative problem as to whether the results attained justify the time expended at this stage of maturity. The objective fact remains, however, that in a period of two years elementary pupils do not attain that degree of maturity in reading which is attained during a like period in approximately equal measure by high-school and by college students.

"One further fact should be pointed out here. In respect to maturity of reading simple material in the vernacular, the elementary pupils, regardless of their level of mental development, show approximately the same type of mature reading habits as is shown by the older groups. When they encounter a foreign language they attempt to carry over to it their basic habits of reading English. The argument is sometimes presented to the effect that it is better to approach the reading of French with a proper reading attitude even with unsuccessful results than to go to the other extreme of deciphering. This investigation has nothing to contribute to such an argument except the objective fact that where this was apparently done, a two-year period was not sufficiently long to produce a degree of maturity equal to that attained by the high-school and the college groups.

"*Effect of Method.* Teachers of both modern and classic languages have inherited a method of teaching which lays emphasis upon language structure and translation. The translation under this method was usually carried on with such a degree of analytical study that the process can best be described as one of deciphering. The direct method of teaching represents a decided break from this older emphasis upon analysis and substitutes in its place an emphasis upon the type of mental activity which when applied to the vernacular is called reading. The psychological distinction between deciphering and reading can scarcely be overemphasized. The difference is clear-cut. When students read they are rapidly fusing the word symbols into consecutive

thought units with no consideration of the words as such. It is only this process of comprehending meaning that can properly be designated as reading.

"Students taught by a direct method attain in two years' study of a foreign language those fundamental habits which are characteristic of the person who reads. Students taught French by an indirect method attain these mature characteristics of reading in a much less degree. Students taught Latin by the indirect method exhibit these characteristics of reading in no degree at all; rather they exhibit in marked fashion the characteristics of the person who deciphers.

"When the objective of teaching a foreign language is ability to read, a perfectly clear-cut choice of methods is possible. A direct method produces desirable reading habits; a translation method does not. This seems to be equally true regardless of the type of language—as applicable to Latin as to French."

Comparative Difficulty of German, French, and Spanish. "German is frequently said to be a more difficult language to read than French or Spanish. The results obtained in this study would lead one to minimize any such differences. Regardless of the structural differences in the three languages mentioned, the results obtained in two years of study are very similar. Furthermore, the processes of reading are similar, the more mature readers following the words in their serial order with few regressive movements regardless of the grammatical structure of the sentence. The process of making the necessary adjustments in order to fuse the words into their proper meaning is a central rather than a perceptual process.

"Two years of studying Latin produced less mature reading habits than in the case of French and German. The explanation of this fact may be that the language is inherently more difficult or that the experiment in the direct reading method of teaching has simply not proceeded far enough to be as efficient as in the case of French and German where it has been tried longer.

"*Results of Two Years of Instruction.* The results secured in this investigation indicate that the middle half of a class either in high school or college does not, in two years' time, reach the level of final maturity in reading. Certain individuals in the groups studied did reach this degree of maturity at the end of two years, and in a very few cases, at the end of only one year.

Subject 63 is an example of the latter case. However, the reading habits of the groups as a whole fall below those of the group of expert or mature readers by an amount which probably represents about a year of additional study, judging from the curves of progress which have been shown.

"When the writer refers to the habits of the expert group, he uses the word 'expert' only in contrast to the groups of students. The expert groups are expert only in the sense that they have made a complete adaptation to the demands of reading ordinary material. They are expert in the sense in which a fifth-grade pupil is expert in reading Selection I in English; he reads it rapidly and comprehends completely the meaning. Therefore, it is reasonable to set up as a goal in reading the type of adjustments made by the expert groups in this study. For the subjects used in this investigation, this degree of maturity was seldom reached in two years' time. This precipitates the question as to whether by a more careful selection of students and possible further revision of methods of teaching this goal might still be reached in two years. There are certain rather strong reasons which suggest that this would be entirely possible, providing foreign-language teachers deem it desirable to attempt such an objective in two years' time.

"In securing the data presented in this report the writer employed the technique of the educational psychologist. However, as a psychologist, his obligation ceases when he has presented the data together with the interpretations which he is able to offer from the point of view of a student of mental processes. The way the data should be used is not a matter for him to discuss. The application of the facts presented must be left to the modern language specialist, who will interpret them from the standpoint of the instructor of modern language and in the light of the desirable objectives approved by his own group."

[Buswell, G. T., *A Laboratory Study of the Reading of Modern Foreign Languages* (The Macmillan Company, 1927), "Publications of the American and Canadian Committees on Modern Languages, Vol. II, pp. 92–95. By permission.]

Most teachers of foreign languages are loth to abandon the purpose of teaching the pupil to speak these languages. Although they may agree that the main purpose in American schools should be that of teaching the pupils to read the foreign

language, they do not like to admit that reading can be taught without a reasonable amount of speech training. The author of the last selection to be presented in this chapter assumes the speaking objective, and applies the psychology of habit-formation to both reading and speaking.

3. LANGUAGE FACT AND LANGUAGE HABIT

Difference between Learning Vernacular and Learning Foreign Language. "In the early days of our profession, accepting unquestioningly the established methods of the classic languages, we viewed the language facts as the only object of consideration. With the demand for a more practical command of the foreign language as a medium of expression, the pendulum swung wide and the conversational or so-called natural method came into vogue especially in the private instruction of teachers of foreign birth. Based wholly on the principle of imitation and paying scant attention to any but the most rudimentary points of grammar, this method consists of a graded series of dialogues, in which the teacher asks most of the questions and prompts the answers. Asserting that since this is the way the child acquires his mother tongue it must therefore be efficacious with the adult, the advocates of this method ignore the fact that even the adolescent mind has already lost much of the imitative facility and verbal retentive faculty of the child mind. The mind of the high school pupil is no longer so plastic for the formation and fixing of language habits. On the other hand habits of hearing and articulation peculiar to the mother tongue have already become so deeply ingrained that they work constantly against the acquiring of the different speech habits of a foreign tongue. Furthermore, under the best of circumstances the pupil has only a minute fraction of the opportunity for hearing and practice enjoyed by the child in learning English.

"Back and forth the pendulum of contention has swung between the classical conservatives and the radical reformers. The one faction, stressing the language facts as the essential foundation, have in view formal discipline and literary culture. The other faction, stressing language habit as the all-important feature, have in view the more utilitarian aim of an oral command of the language, and consequently, their methods have dif-

fered accordingly. As if theory and practice were incompatible, we have seen grammar and oral drill set in opposition to each other, while the truth of the matter is that the acquiring of a foreign language is both a science and an art and demands a conscious assimilation of language facts together with the building up of subconscious habits, which, like all habits, are conditioned upon correlated nervous discharges."

Habit and Verbal Association. "The application of the law of habit to the thousand and one acts of our daily life, such as dressing, walking, playing a musical instrument or running an auto, is a psychological commonplace to all. In all such habitual acts of consecutive movements, it is well known that the conscious mind, the seat of which is probably in the forward part of the brain, operates only as an initial impulse. Without further act of attention the resulting sensation of the first movement stimulates the motor impulse of the next movement; and thus to the end of the series, without any of the intermediate stages rising into the realm of consciousness. In no other way could the semi-automatic character of our most common bodily movements or the rapidity of a musician's technique be accounted for.

"The same principle works in language and is known as verbal association. Just as a musician executes a whole musical phrase without being conscious of the separate movements or even of the individual notes, so in speech the individual words seem to arrange themselves automatically. Of course, if a sentence does not involve idioms, it can be mechanically analyzed into separate words each expressing a thought relation, and each word can be divided into syllables containing a single vowel sound or diphthong with its associated consonants; but in actual speech the sentence is not thus consciously built up of its individual factors. For all practical purposes, the word-group is the logical unit of speech. Although the expression 'quick as thought' is an oft used simile for rapidity, thought is not so quick as nervous reaction. To obtain even the slight oral command demanded in our syllabus, thought, unaided by automatic habit activity, is not quick enough to assemble the syllables into words and the words into groups; nor can the ear untrained to recognize word-groups as wholes mentally seize the individual words of one group before another group demands its attention. Therefore, we must teach the student to form correct habits of

verbal association by persistently making use of the principle underlying all habits, namely, repetition. The most successful teacher is not always the one who can impart information most clearly. He must also be an efficient drill-master, disguising the monotony of repetition by variety of examples. Of course, in all oral drills destined to ingrain correct habits of speech, we should avoid sentences which the student will never under any circumstances have an occasion to use. It is wasted energy to teach him to say fluently such sentences as 'The dog of my cousin is white' or 'Do not pick the flowers in the garden of your uncle's brother' or, to quote directly from a grammar I once used, 'When a young man reaches the age of sixteen or of eighteen years, a mustache grows on his upper lip, and then he is very proud.' "

The Psychology of Drill. "But it is not enough thus by the exercise of the habit forming principle of repetition to equip the student with this intuitive ability to assemble words grammatically and idiomatically, which we call *Sprachgefühl.* This vital element is correct sentence cadence and intonation, generally referred to by the too vague term 'accent.' An English cadence and intonation is so disconcerting to the foreigner that very often he fails to understand a simple sentence that is otherwise correct. While the cadence and intonation of French and German in unimpassioned discourse follow certain definite principles, we must rely in our teaching upon imitation of the native speaker. When we ask a student to repeat after us a sentence or phrase, we must insist that he assemble the words into proper breath groups, and mimic, as it were, the foreign cadence and intonation. In the case of French this feature is so radically different from that of English that a sentence spoken with correct stress and inflection strikes the student at first as funny, and he is embarrassed in his imitation, lest he make himself ridiculous. This mistaken sensation must be overcome by showing the student that the foreign language he is studying has a music of its own, and that the ridiculous situation arises, on the contrary, when the foreign language is spoken with the cadence and intonation of English. That indeed does sound outlandish and we are prone to smile, just as when a Frenchman or German carries over into English his native peculiarities of utterance.

"The learning of the genders of French nouns by rules has long been largely superseded by verbal association with the

definite article, which is a habit-formed process. This principle can advantageously be extended to the teaching of other grammatical facts, such as the government of verbs or the manner in which a verb is connected with a dependent infinitive. Thus if general phrases like *douter de quelque chose, chercher quelque chose, écouter quelqu'un, demander quelque chose à quelqu'un* become thoroughly habitual to a student, he will use those verbs correctly without reference to any abstract rule to which they might be related either as examples or exceptions. If the student will become thoroughly familiar with such phrases as *cesser de faire quelque chose, désirer faire quelque chose, réussir à faire quelque chose,* etc., he can by the force of habit apply them just as a mathematical formula is applied in a problem. He will use the right preposition, or none at all, as the case may be, to connect a verb with its following infinitive. In fact, in using these and many other constructions, there would be no time to recall the rule, if, haply, it were still within recall."

The Rôle of Grammar. "But, by insisting thus far upon the habit element in language, I do not undervalue the importance of language facts or of the methods of teaching them. It has been said that the grammatical method is like teaching physics or chemistry without experiments. Yes, but we must not commit the opposite error of turning students loose in a laboratory without at the same time giving them a knowledge of the theory of those sciences. The most automatic of our subconscious habitual actions were built up by first giving attention laboriously to each step in the process. A systematic knowledge of the grammar is not only compatible with an oral command of the language, but also indispensable to securing it, unless the pupil has enjoyed exceptional opportunities for intercourse with native speakers of the language in question. Without a systematic study of the grammatical facts, the language habits acquired by imitative repetition result in a mere smattering of knowledge, as evanescent as any other reflex nerve activity which is not sustained by constant practice."

The Psychology of Auditory Perception of Foreign Words. "In the matter of teaching pronunciation the correlation between fact and habit is particularly essential. The student who has learned to pronounce by imitation only may be compared to a person who can play or sing by ear only. If he forgets a tune,

he cannot refresh his memory by glancing at the printed score. If he desires to play or sing a piece he has never heard, he is helpless, for the dots, lines and spaces mean nothing to him. Just so, a student of a language which is not spelled as it is pronounced is helpless if he forgets the pronunciation of a word or meets a word for the first time, unless he is acquainted with a phonetic alphabet and the principles underlying it. The word phonetics has often been misinterpreted as denoting an abstruse and recondite subject, apart from the study of the language itself. By phonetics here I mean simply the science and art of pronunciation as applied to the language being studied. For the teacher, a knowledge of phonetics is absolutely indispensable in detecting the errors of the student, in determining the causes of those errors, and in effectively applying the remedy. For the student it drives home the truth that language is not made up of letters pronounced in various ways, but is made up of certain definite sounds which can be readily acquired one by one. Equal emphasis must be laid on the training of the ear and the tongue. A primary reason why the tongue stumbles in articulating new sounds is that the student does not hear correctly sounds which he has not been taught to perceive. He imagines he hears what from the looks of the word he expects to hear, or else he perceives the sound as identical with its nearest English equivalent. With proper phonetic training, combining fact and habit, the student acquires an accurate pronunciation fixed in the memory and he has access to a permanent standard of reference. The international phonetic alphabet as a tool for teaching French pronunciation is widely and firmly established, and in evidence of this fact I notice that practically every one of the new French grammars published within the last year by the prominent book companies employs it, as a matter of course. . . .''

Reading Not Translation. ''But let me not give the impression that I am indifferent to the fact that after all the chief aim for most of our students should be the ability to read the works of French or German literature with appreciation. All my plea for adapting our instruction to the laws of language habit has had this end in mind. It is only by acquiring a subconscious command of at least a small portion of the foreign vocabulary that reading can be done with any enjoyment of the style or foreign atmosphere of the book. Rather than laboriously translating word by

word, phrase by phrase, or even sentence by sentence, one might more profitably read the book in a good printed translation."

[Patterson, A. S., *Language Fact and Language Habit*, "The Modern Language Journal," Vol. I, No. 4 (January, 1917), pp. 136–142. By permission.]

QUESTIONS

1. Point out the differences between the needs and conditions of America in respect to the learning of foreign languages, and the needs and conditions in European countries.
2. Explain: Reading and grammatical diagnosis are psychologically contrasted and antagonistic processes.
3. What is the relation between written composition in a foreign language and reading of that language?
4. What is known concerning the reading of English that may be applied to the reading of foreign languages?
5. Should the study of foreign languages be begun in the elementary school?
6. What degree of facility in reading a foreign language may be expected as a result of two years of instruction?
7. Why is the direct method of instruction in speaking a foreign language psychologically different from the method by which the child learns to speak his own language?
8. Outline the relation between "knowledge" and "habit" in learning to speak a foreign language.

CHAPTER XX

HISTORY

History is one of the means by which we extend our experience by living vicariously the lives of other persons in our own and other lands. In other words, it may be a means of greatly enriching the meaning of present experience. That imagination must play an important part in making the study of history significant is clear on the surface, but Professor Freeman in the following pages treats this subject in considerable detail, and shows the advantages of the psychological analysis of other mental processes underlying the study of this subject.

1. PSYCHOLOGICAL ANALYSIS OF HISTORY

Weakness of Children in Understanding Temporal Relations. "Complete understanding of history includes placing events in a time order. In order that the child may progress beyond this stage, it is necessary that he be able to place the historical personages in past time, and in definite order in time with reference to one another. This rests upon the development of another type of imagination, which we shall call 'temporal imagination.' The stories relating to primitive life of mankind, which are used in the primary grades, do not give the child a true historical notion of the way in which civilization has developed from primitive life down to the life which we find about us at the present time. They prepare him for a later appreciation of such development, much as do biographies. That they cannot give the child a notion based on the conception of the succession of different stages of development in time may be seen from the fact that, according to the Binet Scale for testing intelligence, the average child does not until his sixth year appreciate the difference between morning and afternoon. It is to be said that this scale is too easy for the average American child, but it is such a far call from the simple appreciation of the difference between morning and after-

noon to the understanding of development which has extended through thousands of years, that it is inconceivable that the primary child gets much more than a series of pictures from tales of primitive life. That these tales are suitable for the child from other points of view is, of course, not called into question.

"The idea of long stretches of time is related to the perceptions of short intervals. The child gets his idea of the passage of time and of events, as being more or less distant in the past or future, as an outgrowth from his immediate experience with time. He first must learn to distinguish between events which are near at hand in the past or the future, and then, after time has come to have a meaning for him, he can apply it to the arrangement of more widely separated and further distant events. What we call 'temporal imagination,' or the idea of time, is undoubtedly based to some extent on what may be called the 'time sense,' or the immediate perception of the passage of short intervals of time. Experiments with adults upon the time sense indicate that it is subject to a good deal of variability according to the circumstances. If a person is anxiously expecting some event, such as the arrival of a friend, the time will seem very long. If, on the other hand, he is not definitely expecting an event, and is engaged in some occupation which absorbs his attention, he may greatly underestimate the passage of time. The over-estimation of the passage of time is expressed in the common proverb, 'A watched pot never boils.'

"The child is deficient in time sense. Both experimentation and ordinary observation indicate that the child's time sense is much less accurate than that of the adult, and that the variations due to the manner in which the mind is occupied are much greater in the child than in adults. The child is deficient in the ability to imitate rhythm, and grossly misjudges the lapse of time. A child becomes very impatient when waiting for an expected event. On the other hand, if he is absorbed, it sometimes appears that he has no sense of time. If a child is sent on an errand, and if his attention is attracted by some occurrence on the way, he does not realize the length of time which he spends in stopping to watch the interesting occurrence, and arrives home late.

"The recognition of long periods of time depends partly on the time sense and partly on the observation of external events. The idea of time, or temporal imagination, is undoubt-

edly based to some extent on this fundamental time sense. The time which elapses between breakfast and the midday meal and between this and the evening meal is appreciated vaguely by means of the direct experience we have of the passage of time. In order that the time idea shall be more definite and extend to longer periods, it is necessary that we observe other facts and use them to mark off definite divisions of time. The way in which the larger divisions of time are marked off indicates that we are thus dependent upon external events, and not merely upon our own appreciation of the passage of time, in order that we may get a unit of time and may apply it in the estimation of the longer periods. The year, for example, represents changes in the seasons, the month marks the phases of the moon, the day the rising and setting of the sun, and so on. The smaller divisions of the day, except those between midday and morning or evening, are not distinguished sharply unless we have watches or clocks which give us the means for marking off the hours. The inferiority of the young child in the recognition of periods of time, then, depends partly upon an undeveloped time sense and partly upon the fact that he has not been led to observe the signs which mark the divisions of time, and to use them to set in order his memories of what has happened in the past or his anticipation of events in the future.

"The child learns to distinguish periods of time through his everyday experience. As indicated in the preceding paragraph, the child first makes the distinctions which are called to his attention by the practical needs of his life. He will distinguish between morning and afternoon, when during the forenoon he is promised something which is to occur in the afternoon. Again, during the afternoon his recollection of the forenoon and his discrimination of that period from the rest of the day may be stimulated by conversation about something which occurred then. The distinction between day and night is called sharply to his attention both by the fact that the sun goes down in the evening and rises in the morning, and also by the fact that morning and evening mark important turning-points in his experience, in that he goes to bed at night and gets up in the morning. Similarly, he is led gradually to make the distinction between yesterday and to-morrow through recalling the events of yesterday or anticipating those of to-morrow. The reward or punishment which he may

have received for acts done previously is one method by which this distinction is called to mind; and in a similar way, the promise and fulfillment of results of his actions of to-day call to his attention the coming of to-morrow.

"Longer periods are recognized in the same way. The recognition of larger divisions, such as that of the week, is produced in a similar way by the events of his life which occur at the end of the weekly period. When the child goes to school, his attention is called to the fact that Saturday is marked off by the holiday which occurs on that day, and that Sunday brings a still different manner of life, such as putting on his best clothes and going to church or Sunday-school. The division into still longer periods of time is called to his attention by the presence of other holidays or vacations, or events which occur in a periodic way. His birthday, for example, helps to bring to mind vaguely, and later more clearly, the notion of the year."

Rôle of Number in History. "Number is necessary to the clear idea of long periods of time. Any near approach to an exact notion of the longer periods of time requires that the child shall not only remember and anticipate in a general way, but that he shall make definite the duration of time intervals through the use of number. We can, perhaps, get an appreciation of an hour or a day merely by the direct experience of the passage of time or by the time sense; but the appreciation of a month in any definite way means that we have a definite number idea of the meaning of thirty as a multiple of one day. In the case of the longer stretches, such as a year, it is obviously impossible to appreciate them merely by the direct time sense. We may, therefore, assume that the child gets only a very vague and indefinite notion of longer time until he has a sufficiently clear idea of number to put the time intervals into definite numerical form.

"The abstract notion of even the longer periods may be made somewhat concrete by observing natural events. The appreciation of time through the observation of such events, as well as by means of the number idea, rests upon the forms of experience which the child gets only gradually and does not attain at an early age. All of these forms of analysis of the temporal imagination indicate that it is a matter of gradual growth on the part of the child, and make it clear that the degree of clearness which is necessary for the appreciation of definite historical sequences is

not to be looked for until the child has been in school for at least three or four years. Even then the development is not completed, but is only thoroughly started.

"*First historical narratives should be simple.* These conclusions, if well founded, can only lead to the position that the historical narratives which are designed for the child must at first be simple and easy to follow. In the first place, they must not cover very long periods of time. Even the account of the life of a single individual is beyond the grasp of a child at first. Furthermore, the various series of events must not be complex. It is easier to follow the life of one individual than it is to follow the lives of several individuals who are contemporary with one another. It is easier to follow the history of one section of a country than the parallel histories of all sections. It is easier to follow the history of one country than the history of several countries which are interwoven in their relationships with one another. The difficulty, however, does not depend so much upon the breadth or extent of the fields covered as upon the minuteness with which the train of events within a certain field is followed out. The life of one person may be very complicated if the relationships of this person to others, and to the events of the age in which he lived are followed out in full detail. On the other hand, the history of a country may be made very simple by the selection of a few representative events which portray certain phases of its development. We may say, then, that the history which is designed for a child must be simple, and furthermore, that it is easier to simplify the history of one country than that of several related countries. Therefore, it is best to begin with the history of a single country, and after that has been followed and the child has got some conception of its development, it is time to relate the history of other countries to it."

Connecting History with the Present. "Begin with recent history and pass from that to remote events. The problem then arises as to which country should be treated at the beginning and as to the way in which the history of the country which has been chosen should be developed. The psychology of the development of the idea of time, as it has been outlined, throws some light on this problem. We have found that the child first recognizes the difference of times which are immediately in the past or the future; that he begins with his own personal experience and

reaches out from it before and after. If we follow this same process in the early history which the child is taught, we should begin with his own country, with which he has immediate experience, and should teach the child comparatively recent history at first, rather than begin with remote past time and work forward. We cannot, of course, carry out the principle of beginning from the present and working backwards, in the full and strict sense, as one may reverse a moving-picture film; but we may follow the psychological order by relating the history of events which are near the child and gradually extending them to those which are more remote in the past.

"This method connects history with present life. When we do this, we make of history something which is of immediate connection with the child's present experience, and which lends significance to the problems which arise in his own life and throws some light upon their solution. History may be regarded as an account of the origin of those facts and those beings which are in existence at the present time. In tracing the origin of those facts or beings, we begin with their immediate past and then work gradually further and further toward their more remote antecedents. If we begin, in teaching the child, with the remote antecedents of present-day people, or with the remote causes of existing physical objects, he loses the connection between the present results and the remote past cause. He then fails to get the conception of history as having a direct and important relationship to his present-day affairs."

Spatial Imagination. "History involves spatial imagination. Historical events are, of course, not only related in time, but are also related to one another in space, since they take place at particular localities upon the earth. The child is required, therefore, in any complete appreciation of history, not only to be able to put the events together in a certain time order, but also to create in his imagination the geography of these events. . . ."

"The child at first fails to make allowance for the differences between past and present life. When the child is first told of persons or places which existed in the past, he has a strong tendency to think of them as like the persons with whom he has been familiar in his own experience. He merely transfers in imagination those things, those scenes, and those persons which he has met in his own life to a previous period, and puts them into the

story which the history relates, modifying them as may be necessary to suit the events. In his early acquaintance with history, the child does not recognize the difference in the physical surroundings, or the difference in beliefs and mental attitudes, which characterized people of past time in contrast to those of our own time.

"The difference in physical surroundings is appreciated first. The ability to appreciate the difference in physical surroundings is the easier one to acquire, and the one which the child can acquire in a more or less superficial way by the use of pictures and other concrete means of representation. Still, it requires a fairly good degree of ability in constructive imagination to picture to one's self clearly the houses, the landscapes, and the costumes of the people of past times.

"The appreciation of differences in mental attitudes is difficult even for adults. The difficulty of realizing to one's self the difference in physical surroundings is very much less than that which attaches to the appreciation of the differences between the mental attitudes of persons of past time and those of our own contemporaries. Even our ancestors of one hundred years or one hundred and fifty years ago differed from us so radically on certain questions that it is difficult for us to understand how they could have held some of the beliefs that were common. To take an example from our own country, a justification of the attitude of the colonial settlers toward witchcraft is inconceivable to us. It is even becoming difficult for us to understand how there could have been any real difference of opinion on the question of slavery. If an adult finds it difficult to project himself into the mental life of a past people, even of those who are his immediate ancestors, it is an impossibility for the child to do so with any degree of completeness."

Attitude of Tolerance. "The historical sense extends the attitude of tolerance to persons who lived in the past. This type of imagination, which has been called the 'historical sense,' is in reality merely an extension of the process which the educated adult carries on when he gains a proper degree of insight into differing points of view of other persons with whom he comes in contact. Various groups of people in the same society differ in their attitude on all sorts of questions. A hidebound adherent to one political party can as little conceive how any one can con-

scientiously uphold the foolish principles of the opposing party as can the average person of this age conceive how a rational person could have believed the things which our ancestors believed. What we are considering here is merely the extension to wider differences of this same tolerance and understanding. This extension must be built upon somewhat more abstract material. In understanding the attitudes of historical persons we have to create for ourselves their lives and attitudes on the basis of written records and traditions, rather than on the basis of contact and conversation with them. We believe that an increase in tolerance is being attained by modern civilized people, and similarly, the historians tell us that the fully developed historical sense is distinctly a feature of modern scholarship."

Understanding Motives. "The historical sense has little possibility of development before adolescence. The child can begin at a rather early age to gain in appreciation of the difference in physical surroundings of past people, but the full development of even this type of historical sense is not consummated early. The higher type of historical sense, which deals with mental rather than with physical facts, is probably very slightly developed before adolescence; and then it has only a gradual growth. It appears from the recorded observations and investigations of children that the ability to appreciate the motives of others, to understand motives which are different from one's own, and to judge of one another's conduct by considering motive as well as actions, is an attainment which is not reached before adolescence. If this is true, it is futile to attempt to discuss with the child to any great extent the differences in point of view between ourselves and people of the past, and to explain them on the basis of the growth of morals or of customs, as can be done with the older pupil. . . .

"Two other forms of mental ability are prominent in the appreciation or study of history in its full meaning, although they are not, strictly speaking, forms of imagination. In order to round out our account of the mental processes in the study of history, however, we may include a brief discussion of them.

"History attempts to explain events by previous conditions and events. The first form of history in the mind of the child is merely a narrative, that is, a series of events occurring in time. These events are related to one another, but not in such a way as

to make prominent the idea that the later events grow out of the earlier ones as their cause. The degree to which the study of cause and effect can be carried on in history is a question on which there is a division of opinion. Some students of history have attempted to give a very minute account of the course of human events as illustrating the law of cause and effect. The discovery and formulation of general laws with reference to historical development has been attempted. Although one may not agree with the extreme form of this view, yet historians do occupy themselves with such questions as are being considered at the time of this writing with reference to the European war. Not only historians, but all persons who have any interest in the matter, are desirous of knowing what the causes of such a tremendous conflict are. Was the war caused by the machinations of a few individuals, or by the ambitions and desire for territorial expansion on the part of a war party; or was it caused by the expansion of peoples, or their desire to gain for themselves the good things of the earth; or was it caused by an inevitable conflict of races; and so on? In order to gain any light at all on such questions, we must study events which have led up to such a consummation as this, and we must give these events an interpretation. As in the case of the historical sense, it is probable that children gain little appreciation of this phase of history until they reach the adolescent period.

"*Critical Examination of Sources.* Another phase of the study of history has not to do so much with the understanding of historical facts after they have been gathered and determined upon in the first place. Ancient historians discriminated very little between tradition, which had no foundation in fact, and reliable sources of evidence. We may say that what is regarded as the scientific method of obtaining facts is the most prominent characteristic of modern historical scholarship.

"The examination of historical sources is an examination of witnesses under difficulties. In order to ascertain the reliability of records which purport to be historical, it is necessary that the same procedure be carried out, in a modified and more difficult form, that is taken to find out the truth regarding contemporary facts. Courts of law have developed an elaborate procedure by which facts in a disputed case may be discovered. We know that, even in the case of current events, it is difficult

to be sure what is the truth and what is fiction. The examination of witnesses and the criticism of their testimony are now being studied in a scientific way. We may regard historical records as testimony of witnesses to be examined in the same way, with the added difficulty that they cannot be cross-questioned. The possibility of prejudice or of the distortion of evidence because of personal interests are matters which have to be considered. When a historian attempts to determine what are the facts in regard to the conduct of a war, for example, he can find conflicting evidence in newspaper reports which are published in the different countries. It is his business to decide what the truth is by comparison of the different sources of evidence.

"Critical examination of sources is too difficult for high-school pupils. It is sometimes the fashion to use a good deal of source material in the teaching of history to young people. It is questionable, however, whether they are able to carry on the very difficult and complicated sort of examination of sources which is necessary to get anything of value from them. It is perfectly possible and altogether desirable to make historical accounts concrete and vivid by introducing certain forms of source material which are agreed upon as reliable and which do not need to be examined critically. But this is a different matter from the examination of source material for the purpose of determining upon its reliability. It is probably safe to say that practically none of this kind of examination of sources is suitable for the pupil of high-school age, and that little of it can be done to advantage before the later years of college work."

[Freeman, F. N., *The Psychology of the Common Branches* (Houghton Mifflin Company, Boston, 1916), pp. 145–160. By permission.]

The culture-epoch theory, based on the so-called biological law that racial and individual development run parallel with each other, has in the past been put forward as a psychological reason for teaching history in the order corresponding to the development of man from savagery to civilization. Professor Johnson, having examined this doctrine and rejected it as a solution of the problem, proceeds in the passages that are herewith presented, to examine other psychological grounds that may be more valid for determining how history instruction may be properly suited to the child's understanding.

2. PRINCIPLES FOR DETERMINING THE BEST ORDER OF PRESENTATION

From Near in Time and Space to Remote. "Another conception often applied is that history in school should begin with what is near in time and space and proceed by gradual stages to what is remote. The assumption here is that what is near is intelligible, that out of it may be formed an 'apperception mass' sufficient to assimilate the less near, that through the resulting accretion it becomes possible to assimilate the still less near, and so on to the remote. The first step is commonly a study of the home and its activities. This is followed by a study of the school and its activities, and this in turn by a study of the local community as a whole, its geographical environment, its industries, its social customs. Attention is then directed, by means of simple stories, to past conditions and happenings in the community. The way is thus prepared for a similar treatment of other communities and for a consideration of the relations of one community to another. After four or five years of this kind of experience the historical sense is usually considered sufficiently developed to justify a chronological treatment of such history as may seem desirable. In the earlier stages the method is often regressive. The pupil, that is, begins with the present and works his way backward into the past. . . .

"The soundness of using the pupil's own immediate environment as a point of departure in the study of history is beyond dispute. In every lesson throughout the history course there should be a constant passing from the near to the remote, and, it may be added, from the remote to the near. The principle is fundamental, but it is scarcely a principle of grading at all. The degree of nearness or remoteness can afford no adequate test of difficulty. The question, for example, of whether Socrates or Benjamin Franklin is the more suitable for study by children is scarcely to be answered by an appeal merely to the years or the miles that separate Socrates or Benjamin Franklin from us."

The Doctrine of Natural Interests. "The doctrine of natural tastes and interests, the culture-epoch theory, and the principle of proceeding from the near to the remote, as actually applied in the construction of history programs, have, it must be admitted, been found to 'work' in the sense of providing materials that are

intelligible and interesting to children. This, in the opinion of some advocates, is a sufficient test of validity. But, waiving all other objections, it is clear that the answers thus returned to the question of what is possible for children are at best partial answers and that such must be the result of applying any doctrine, theory, or principle, that limits at the outset the range of inquiry. For more general answers there must be a more general exploration of the field."

Three Kinds of Facts to be Presented. "The past to be reconstructed embraces three general kinds of phenomena: (1) physical human beings and their physical environment; (2) human words and actions; (3) human thoughts, feelings, and resolutions. Historical information, however organized and however presented, can be reduced to facts that relate to one or another of these general kinds of phenomena, or to their interrelations. There may be, then, in the conditions under which facts of the types thus indicated are or may be apprehended some hint of the possible range of selection."

Appeal to the Senses. "The conditions presented by facts of the first type are in many cases such that a direct appeal to the senses is possible. The eye can still rest upon a house that George Washington lived in, a hat that Napoleon wore, the food that some Pompeian was about to partake of when the great calamity came, the very features of an ancient Egyptian king. The ear too, may have its part. The clocks of our grandfathers are still striking for us; church bells heard in the Middle Ages are still ringing for Europe. The sights and sounds of nature, the odors of wood and field, repeat themselves from generation to generation. Furthermore, much of the material past lends itself readily to direct representation in statues, casts, models, and pictures, such as are now being supplied in ever increasing variety for every country within the pale of general human interest.

"The conditions presented by facts of the second type admit to some extent of similar appeals. The actions and spoken words of the past are of course never before us in quite the way that material remains may be. No one can now actually see or hear Julius Cæsar dictating his *Commentaries,* or Henry IV going to Canossa, or William Penn talking with the Indians. The only actions which can be directly observed now are actions which are in progress now. But many acts habitually performed in the

present resemble acts habitually performed in the past—going to school, greeting guests at a reception, saying mass. Many more can by conscious effort be performed more or less after the manner of former times—kindling a fire with primitive apparatus, spinning with an antiquated wheel, brandishing a tomahawk. An elaborate illustration of this type of reconstruction, whatever the originals might think of it, is afforded by the numerous characters that walk and talk before the footlights in the historical drama. Action can also to some extent be suggested by statues and ordinary pictures. It can be fully represented in moving pictures. Nor is this all. By the correlation of moving pictures with the phonograph it is possible not only to represent action itself but to reproduce the voices and other sounds that accompanied action."

The Difficulty of Representing Mental Attitudes. "The conditions presented by facts of the third type admit of no such appeals. Thoughts and feelings can neither be painted in pictures nor caught by any mechanical contrivance that has yet been invented. They are revealed, so far as they are revealed at all, in the 'looks' of men, in deeds, and in words. There are, it is true, mental states of our own that resemble the mental states of men in the past, and it is to our own mental states that we habitually appeal in representing to ourselves the mental states of others. But even our own minds are, to most of us, more or less of a mystery. Who has not despairingly remarked after some act that seemed anything but complicated, 'I wonder why I did that!' The mental states of a cave man, an Indian, a pioneer, a Clovis, a Charlemagne, a Napoleon, have the advantage of being plainly described for us in our textbooks. But even with this advantage our ability to understand them depends upon our own mental experiences and upon our ability to analyze our own mental experiences.

"But, it may be urged, most of the facts of history are, regardless of their kind, on exhibition in verbal description only. For most of them the conditions are, therefore, equalized. In the first place, verbal description is usually inadequate. It rarely tells us all that we need to know to reconstruct either a material object no longer seen or a past mental state. In the second place, words are symbols only, mere 'signs of psychological operations.' The images which they call up, the thoughts

and feelings which they induce, alike vary with individual experience. There is some force in these suggestions. The elements with which the mind has to work in constructing from verbal description its images of the vanished externals of life are, however, still in the domain of the senses. Is it a building that is described? We have seen buildings. Are the dimensions given? We have used a foot rule. Were the walls a dull red? We have seen dull red. The details, so far as they go, can be referred to memories of sensory impressions and these can be verified, if necessary, by fresh appeals to buildings, a foot rule, and dull red. Is it an action that is described? The appeal is still to memories of sensory impressions and some verification through appeals to action itself is still possible. The elements with which the mind has to work in constructing from verbal description past thoughts and feelings remain more elusive and in general more dependent upon the mind's own previous experiences.

"Within these general types of facts there is, however, a further distinction. The facts may be either particular or general. They may relate in detail to individual objects, individual persons, individual actions, thoughts, or feelings. They may in varying degrees of abstraction summarize individual objects or persons. They may relate wholly to groups of objects or persons, to collective acts and sentiments, to those habits and usages which are called institutions, to general causes that act in history. A slave we can image, but what was the 'Slave Power' in America? Groans we have no doubt heard, but what is 'a groan from the heart of France'? Opinions we have no doubt expressed, but what is 'public opinion'? How shall we represent to ourselves a panic, a revolution, the church, the state, society itself and the laws of social action?

"The simplest problems in dealing with history are evidently those connected with forming conceptions of how the world and its activities looked in the past. The more difficult problems are those connected with forming conceptions of past mental states. Particular facts, whatever their type, are simpler than general facts of the same type. There is, moreover, a certain kind of dependence of the higher upon the lower forms of representation. External material conditions and activities, to the extent that they were either cause or effect of past mental states, furnish necessary clues to the interpretation of past

mental states; particular facts furnish necessary clues to the interpretation of general facts.

"In the field of external conditions and activities anything that can either be observed directly or be so presented as to supply elements for definite imagery is obviously possible material for any stage of instruction. Children in the first grade of the elementary school can, given the proper kind of presentation, image primitive dwellings, primitive furniture, primitive tools, primitive weapons, primitive men, and the actions of primitive men. They can also, given the same kind of presentation, image dwellings, furniture, tools, weapons, men, and actions of men, in any degree of removal from primitive conditions. The time exposure needed for imagery increases of course with the amount of detail to be imaged. It is in general greater for the material aspects of the higher civilization than for the material aspects of the lower civilization. But given the time, and given the same kind of presentation, the material aspects both of the higher and of the lower civilizations are within the realm of the possible for children.

"In the field of thoughts and feelings the range of possible selection is still largely determined by the mode of presentation. Thoughts and feelings directly and obviously related to external conditions and activities that can themselves either be observed directly or be so presented as to supply elements for definite imagery are at any stage of the elementary school within the pupil's power to interpret. The feeling of need for a fire or of food for a dinner, the joy of accomplishment in fishing or hunting, the desire to visit a friend or to shun an enemy, the thought of the next day's work or adventure, in the presence of definite images of the thing needed, accomplished, desired, or thought of, all have a meaning for children of six. It is easy, however, at any stage of instruction to claim too much for the thoughts and feelings which pupils attribute to the past, and hence to demand too much. A pupil studying, for example, the Battle of Lexington, 'must,' we are informed, 'completely identify himself with the thought, passion, and resolution of the time.' * The philosopher who said this began to doubt it in his next sentence, but the statement may stand as fairly repre-

* Tompkins, A., *Philosophy of Teaching*, p. 171. By permission of Ginn and Company.

sentative of a kind of emphasis frequently met with in discussions of history teaching.

"The mental experiences with which children are thus expected to identify themselves are at the beginning of instruction usually those of primitive men. The simplicity alleged for such experiences is, however, largely a simplicity of conditions of presentation. The thoughts and feelings introduced are thoughts and feelings directly and obviously related to external conditions and activities that can themselves be presented concretely. Highly civilized men have thoughts and feelings similarly related to externals that can themselves be presented concretely. Are these less available? Is it easier to realize the elemental bodily sensations of a savage—hunger, thirst, cold, fatigue, toothache, headache—than to realize the elemental bodily sensations of a civilized man? Is it easier for country children to think the ordinary thoughts of a primitive farmer tilling the soil, gathering his crops, trading with his neighbors, grumbling about the weather, gossiping before his fire, than to think the ordinary thoughts of his most advanced successor similarly engaged? Is it easier for city children to think the ordinary thoughts of some dweller in ancient Babylon than to think the ordinary thoughts of some dweller in modern New York? The answer is that neither is sufficiently easy to make comparisons decisive. 'Breathing the atmosphere of departed days,' 'catching the spirit of bygone times,' and 'living the past' are, even from the point of view of adults, in large part empty exaggerations. Applied in school to attempts at reconstruction of past mental states, whether of primitive or of highly developed human beings, such phrases are in large part suggestive of exercises in rhetoric for teachers rather than of exercises in history for children.

"Particular facts relating to external conditions and activities are plainly the A B C's of history. They are the facts most readily apprehended. They can without prohibitive strain on the intelligence be so treated as to bring out from the beginning differences in conditions and thus be made to illustrate the fundamental historical idea of change in the world. They can be so selected as to cultivate from the beginning a sense of proportion. There is a temptation that is almost constant, in dealing with history for beginners, to build a past peopled only by the

very fortunate and the very unfortunate, a past of palaces and prisons, of Fields of the Cloth of Gold, and Gallows Hills. History thus tends to become sensational and to mirror the past much as the 'yellow' journals mirror the present. It is among the merits of the externals of normal human life in the past—buildings, clothing, food, tools, roads, bridges, conveyances, weapons, occupations, amusements—that they are, as a rule, sufficiently different from those of the present to produce, without overemphasis upon what is exceptional and extreme, that effect of picturesqueness which is deemed essential in arousing the interest of pupils. This makes it possible to look in a serious way for facts that are really characteristic of former times and to seek in characteristic facts for the really characteristic elements. Even the fundamental historical idea of continuity can to some extent be illustrated. All that is necessary is to present action following action, to make the story of action a continuous story, to give it a beginning, a middle, and an ending, and to apply the same principle to a series of stories. Finally, external conditions and activities are the key to such mental experiences as are admissible for beginners."

General Concepts of Advanced History. "If the views here presented are correct, the general distinction between elementary history and more advanced history is fairly clear. Elementary history is made up essentially of particular facts. It is history presented in the form of concrete examples—actual remains, physical representations of actual remains and of actions, verbal description rich in material for imagery. Advanced history is history presented in the form of general concepts. Concrete particulars relating to actions, actors, and the material world in which they acted can be introduced at least as early as the first year of the elementary school; general concepts relating to similar actions, similar actors, and a similar material world may be too difficult even for the high school. Concrete particulars can be so selected as to convey to a first grade measurably correct impressions of the past; general concepts may convey erroneous impressions even in the high school. Concrete particulars can be so treated as to illustrate to a first grade the fundamental historical ideas of change in the world and of continuity; general concepts may fail to convey these ideas even in the high school. Similarly past mental states directly and obviously

connected with concrete particulars can be understood by a first grade; general concepts of similar mental states may be meaningless even in the high school.

"The problem of adapting history to the schoolroom is, therefore, essentially a problem in presentation. Facts presented concretely are elementary; facts presented abstractly are advanced. For the earlier years of the elementary school, history should be made up essentially of concrete examples. It should be descriptive and narrative rather than analytical. Generalizations when introduced should be of a kind that can be readily resolved into concrete particulars. This does not mean that history in the elementary school must be a series of pictures and the children should have no opportunity to reason, to generalize, and to apply their conclusions. It only means that the data for reasoning, for generalization, and for application must be concrete data. History thus constructed and thus presented for five or six years will lead naturally in the upper grades to history more largely made up of collective or general facts. With pupils of ten or eleven, concrete particulars must still be paramount; with pupils of seventeen or eighteen, concrete particulars must still be continued, but discussion should and may turn largely on generalized history.

"One condition common to all historical facts, and one that presents a somewhat special problem, remains to be mentioned. Historical facts are localized facts. They belong to particular times and particular places. If these relations are suppressed, the facts cease to be historical. A fact may be localized in a general way: once upon a time, long ago, before we were born, on an island in the sea, in a far-away country, in the southern hemisphere. It may be localized in a more particular way: Columbus sailed from Spain in 1492; from Palos, Spain, in August, 1492; from the bar of Saltes at eight o'clock, Friday, August 3, 1492. The degree of definiteness with which a fact should be localized depends upon a variety of considerations. some of which are quite arbitrary. Sometimes an event is so famous that it is a part of common information to know when and where it happened. The event may not be really important, but that does not matter. Romulus Augustulus must have his 476 A. D. Sometimes historical characters must be kept where they belong to avoid embarrassment to grave conclusions. A

St. Louis newspaper, some years ago, by putting Thomas Jefferson into the Convention of 1787 succeeded in getting the Declaration of Independence into the Constitution. Just what events shall be localized very definitely and what events shall be localized in a general way only is a part of the larger question as to what facts really are significant in history. But localization itself is something more than an arbitrary device, it is more than a convenience, it is a part of the very conception 'historical.' ''

[Johnson, Henry, *Teaching of History in Elementary and Secondary schools* (The Macmillan Company, New York, 1926), pp. 38–54. By permission.]

As Professor Bagley points out in what follows, history and literature are most frequently cited as the chief means at the disposal of the school for the inculcation of ideals. Bagley divides the ideals of history into two types, national and universal. If we add to these the more purely personal ideals that are almost certain to arise through the study of history, it will be seen that the teacher faces a heavy responsibility at this point.

3. IDEALS AS DEVELOPED BY HISTORY

National and Universal Ideals. ''History, biography, literature, art in any of its forms, and religion are the chief sources of materials for the direct development of ideals. The ideals that history embodies are of two types,—national ideals and universal ideals. Both are fundamental controls of conduct, operating almost daily in common life. The community of conduct in any group of civilized people is evidence of the potency of national ideals.

''Instances illustrating this point will come readily to the minds of those who have traveled in different countries. The Englishman has standards of conduct different from those of the American, the German standards differ from those of the Englishman, the French standards from the German, and so on. The Englishman, for example, has a certain contempt for free schools; the American stakes his nation's future on free schools. This difference in educational ideals is a controlling factor in the life of the two countries. The German has an ideal

of frugality and national economy that neither Americans nor Englishmen attain. He willingly obeys laws with regard to property that Americans at least would not respect. The Parisian has ideals of home life and family relations that are not acceptable to the Anglo-Saxon mind.

"These differences may have some basis in the natural constitution of different peoples; but that this basis is, at best, very slight, is evident from the ease with which ideals are changed when people of one nationality take up their residence in a foreign land. This is especially to be noted in the European immigrants who have settled in America. In two generations, at most, almost every trace of the European ideals and prejudices is completely eradicated."

American National Ideals. "Among the national ideals which distinguish Americans from other peoples are those of individual self-reliance and equality of opportunity. There are other ideals which we hold in common with other nations—especially England: civil liberty, local self-government, national unity, and representative democracy. These national ideals control the conduct of the component members of the body politic not only in those adjustments which have reference to government, but also in many little matters that concern only the individual himself. In virtue of his national ideals, the American sends his children to a free public school, and sometimes permits the public to supply them with books and other materials, even though he himself may be far better able to make the purchases than many of those who are taxed for the purpose. He may not always reason out carefully why he does this, but sometimes he does, and then his reasoning might conceivably run something like this: 'Education opens opportunities that must be equally offered to all children. I can easily afford to pay for the education of my children, but to do so would be to place the free schools upon a charity basis. I may be able to purchase books for my children, but to do so would be to place free books for indigent children upon a charity basis. In either case, I should be interposing an obstacle between the mass of children and the education which is their right, for I have in effect pauperized one class at the expense of another. Therefore, to equalize opportunity, I send my children to free schools and let them accept free text-books and supplies.' This is conduct

that is controlled by an ideal. The ideal is 'equality of opportunity.' This ideal is undoubtedly realized in America in far richer measure than in any other country, and it is this ideal that America stands for as it stands for nothing else.

"Again, in virtue of his ideal of local self-government, the American citizen undergoes certain disadvantages that would not be his lot were he to adopt a centralized system of government. He taxes himself for innumerable bits of governmental machinery,—legislatures, executive staffs, judiciaries,—the function of which could be much more economically fulfilled by fewer centralized officials and representative bodies. He does this willingly, and often with full knowledge of the disadvantages involved, because he not only believes but *feels* that, in spite of the cumbrous system, certain priceless liberties are retained by him that would otherwise be abrogated.

"In virtue of his ideal of representative democracy, the American citizen intrusts his government to the hands of many individuals, although he knows that governmental efficiency is best subserved by concentrating its functions in a few individuals. The ideal determines his conduct, impels him to sacrifice a certain measure of efficiency in order that he may *feel* that his own interests have the chance of representation.

"It is one function of the study of national history to impress these national ideals upon each succeeding generation. Certainly other forces are operative in the conservation and perpetuation of these ideals. They are expressed in the life about us,—in the institutions of society; and imitation and suggestion, unaided by formal education, would tend to perpetuate them. But their vitality and stability may be greatly increased and strengthened by the study of history, for history may lead the child vicariously to repeat the experiences through which the ideals have developed. It was said in a former section that the direct utilitarian value of history was inconsiderable, inasmuch as the facts and generalizations of history were only infrequently applied to existing situations and then with no certainty that the predicted results would follow. It is not the facts and principles of history that the present and future generations will apply; it is rather the emotions and sentiments which these facts of history evoke in the mind of the student that will operate to determine future events.

"But the value of history is not limited to the national ideals that its study develops. Historical personages and historical events constantly typify certain universal ideals,—certain ideals that function irrespective of national or ethnic bonds. Courage, fortitude, initiative, efficiency, foresight,—in fact every conceivable human virtue may be given a surer footing in the individual mind through the study of history and biography; although here, also, the suggestion of the immediate social environment exerts a powerful influence,—and an influence that often needs to be counteracted."

The Vitality of Ideals. "From what source is the emotional force essential to the vitality of these ideals to be derived? In national history, unquestionably, the instincts that are stimulated by kinship, or blood-relation, form an important factor. The virtues of Lincoln's character appeal with stronger force to Americans than to Germans because Americans recognize that Lincoln was one of them. Needless to say, the feeling of kinship can be stimulated, even though the actual blood-tie be non-existent. Community of interest is afforded by national life, and this gives rise to emotional factors almost as powerful as those that are afforded by actual blood-relationship. The figures in world-history whose sphere of activity lies outside of our own race or nation appeal to us less strongly than do our own heroes; the ideals represented by Napoleon or Bismarck will, in general, lack the emotional force of those represented by Lincoln; nevertheless, conspicuous virtues and abilities excite admiration, it matters not in whom they may be found."

[Bagley, W. C., *Educational Values* (The Macmillan Company, New York, 1911), pp. 164–168. By permission.]

QUESTIONS

1. Is temporal imagination essential to the study of history? Why is the child's temporal imagination so deficient?
2. Show how the understanding of abstract number relationships is an aid in the study of history.
3. How does the principle of apperception apply in the study of history?
4. In what way may history be used to inculcate the ideal of tolerance?
5. What significance should the problem of evaluation of sources have for the high school pupil?
6. In what sense is "from the near to the remote" a correct principle in presenting history?

7. How does the distinction between the concrete and the general apply to the study of history?
8. Point out some instances of what you believe to be differences in national ideals. How do you account for these differences?
9. How do such ideals get their vitality?

CHAPTER XXI

SCIENCE

1. THE NATURE OF SCIENCE

"*Sensory Experience versus Science.* The effort to make science a universal possession encounters difficulties. The common man has complete confidence in the testimony of his senses. The experience of the common man is limited, but it is vivid and therefore seems to him very reliable. For these reasons, the common man not infrequently rejects the teachings of science.

"Let us take a simple illustration of this fact. The individual who observes the appearance of the world about him gets a certain series of sensory impressions from the flat land and the expanse of water which he observes. His notions of the world will at the outset be limited by that which he can see and by that which he can observe in the course of the limited travels which he is able to make.

"When Newton formulated the hypothesis that light is a form of vibration, he took an intellectual step which has only slowly been followed by the race as a whole. To his mind, this step was necessary in order that he might give a coherent account of the facts which he had observed. When he saw white light broken up into various different colors, he had to account for these colors through some explanation which recognized white light as a composite fact instead of the simple fact which it seems to be.

"The step which was taken by Newton does not need to be taken in exactly the same way by all those who subsequently believe that white light is composite and that colors are different rates of vibration. Once a genius has formulated a scientific explanation, its subsequent acceptance is relatively easy because the way to an explanation of the phenomena has been pointed out. In fact, it has been the function of leaders in scientific thought to mark out paths of rational thinking through the

bewildering arrays of facts that accumulate in human experience. In every field of scientific investigation facts accumulate and seem chaotic until the penetrating insight of some vigorous mind sees the way through the mass. . . .

"Even after the scientific discoverer has pointed out the method of synthesizing and explaining the facts of experience, there is required of those who follow the leader's mode of thinking a power of thought which is higher than that of mere observation. One who accepts a scientific explanation and much more one who understands the explanation must think in abstract terms and must be able to grasp in a single coherent system an elaborate group of experiences.

"*Verbal Formulas as Substitutes for Understanding.* There is a serious danger which arises at this point. Human social relations have been highly perfected through language. Anyone who has an idea and formulates it in words can transmit the words very readily to other human beings. The recipient of the words may or may not be stimulated by hearing them to participate in full in the abstract general thought which they express. A scientific principle formulated in words conveys meaning to the discerning mind, but it may convey nothing but words to a mind which does not have the power to follow the processes of scientific reasoning. The very facility of verbal expression thus becomes a danger. How real the danger is everyone knows who has observed some of the superficial results of science instruction which appear in many schools in which pupils recite scientific statements but do not understand them.

"A sharp distinction is to be drawn between three types of mental activity which can be induced by reading a statement of a scientific principle. First, the pupil may learn to repeat the words of the statement without having any real knowledge of the meaning or importance of the verbal formula. Second, the pupil may have some idea of the meaning of the statement and may go so far as to see its relation to his other experiences. He adopts in this case an attitude of acceptance of belief. Third, he may use the statement as a guide for his thinking and through the use of this guide may arrange the facts of his own experience in a systematic way, thus arriving not merely at an acceptance of the principle but also at an understanding of the method of thought by which the principle was derived.

It is hardly necessary to add that such an understanding is the most valuable outcome of teaching.

"*Textbooks and Laboratory Exercises.* Teachers of the sciences must give much attention to the methods of presenting their subjects to pupils in order to insure, if possible, the best form of assimilation. In general, it is agreed that a textbook course in science is undesirable because it permits and even encourages pure verbalism. The demonstration method is regarded as more promising than the textbook method because it brings pupils into direct contact with the facts and at the same time encourages them to think of the explanation of what they observe. The laboratory method has been widely advocated as the most advantageous method. It is said that this method not only brings the pupils into direct contact with facts but compells them to select the facts which are needed for generalization and provides opportunity to formulate generalizations without the aid of the teacher.

"While it is doubtless true that even textbook science is in some cases effective in stimulating pupils to discover explanations and that laboratory exercises often become quite formal and fail of their purpose, it is certainly true in general that science-teaching is more likely to succeed when the pupil is brought into direct personal contact with the situations from which scientific principles have been derived.

"*Broader Relations of Scientific Knowledge.* Even under fairly favorable conditions of instruction, when pupils understand the principles of science, they very often fail to relate the principles which they learn in the science course to their experiences outside the science classroom. The pupil learns the lessons taught by physiology but does not apply them to his own life. The pupil studies chemistry but is unable to explain the facts which he observes in domestic life. There is a synthesis of knowledge which is higher than science; it is that synthesis which unites scientific thinking and all the experiences of life. We may call this higher synthesis the application of science to all the practical and theoretical situations which the individual encounters. This final achievement of scientific thinking in all the situations of life is a goal which is by no means generally attained.

"*Science and Practical Applications.* It is very seldom true in the modern world that a single individual is both a scientist and a practical inventor. The methods of thought and habits of life which are necessary for scientific research are highly special, and the person who cultivates them is likely to find his attention fully absorbed and his time fully occupied without attempting to find applications. In like manner, the ordinary man finds himself engrossed in business or agriculture and does not have the disposition to concentrate on scientific research.

"*Stages of Scientific Comprehension.* An illustration of the different attitudes assumed by different members of society toward scientific methods and scientific results can be found in the field of medical science.

"The science of medicine instructs the ordinary individual that he should take a certain drug if he is suffering from a certain malady. If he has malaria, quinine taken into his system will help to cure the disease. He need not know in any detail what quinine is and what malaria is. He need not know what types of experiments were carried on in order to establish for medical science the knowledge of the curative effects of the drug. All he needs to know is that some authority in whom he has confidence prescribes quinine for him in his present condition.

"The student of pharmacy may go a step further. He may know something about the character of quinine and the sources from which it is derived. He may be instructed also as to the physiological effects which are produced by this drug. There are many remote problems which suggest themselves the moment these simpler ideas about quinine are acquired, but the pharmacist often leaves these problems to someone else. The chemical reasons why the organism reacts to quinine in the way in which it does need not be understood by the student of pharmacy. All that he needs to understand is that the effect is produced and that the drug which produces the effect can be procured from certain sources and should be handled thus and so after it is procured.

"The physiological chemist is not at all satisfied to know merely the phenomena which result from taking quinine into the system. He asks the more profound question of the chemical relations that are here involved, and he insists on carrying his

investigations forward until he secures some adequate knowledge of the relation between the bodily tissues and this particular drug.

"Society is made up of laymen who take quinine, pharmacists who know something about procuring the drug, and physiological chemists who are carrying on researches in the effort to determine the exact reasons why the bodily tissues behave as they do under the influence of quinine.

"*Specialization of Attention.* The explanation of the fact that some individuals are satisfied with incomplete knowledge is to be found in the general law of mental life that the range of attention is limited. An individual can hold in mind only a few facts. If many facts are offered, some of them are neglected. The common man and the pharmacist have concerns in life other than the study of quinine, and such energy of attention as they possess is absorbed in the mastery of these other concerns. They are therefore satisfied to leave to the physiological chemist the more fundamental scientific study of the drug since this type of study is beyond the range of their interest and power of mastery. . .

"The distinctions which have been drawn between different types of mastery of scientific principles and different personal relations to these principles make perfectly clear the reason why the introduction of science into the high school is a difficult matter. How far is the ordinary pupil to be instructed in the observations and methods of science? Is the pupil who studies physics in the high school to be given a few formulas and to be confronted with a few demonstrations of the way in which physical nature behaves, or is he to be asked to become conscious of the methods that have been employed in the physical sciences? There can be no doubt that in theory the scientists have thought it desirable to give the high-school pupil some mastery of scientific methods as well as to make him acquainted with demonstrations of results and applications of principles to practical situations. It is equally clear from the history of education that scientists have found themselves confronted by grave obstacles when they have attempted to make any large number of the mixed group of pupils found in the American high school acquainted with scientific methods. . . .

"The difficulties which pupils encounter in the study of science will perhaps be made clearer if we consider some of the details

of the thinking involved in science. In the first place, science finds it necessary to supplement ordinary experience by collecting facts which are often far beyond the range of common observation. Extreme examples of this are to be found in the use of the microscope and the telescope, by means of which facts are ascertained which are inaccessible to the senses of human beings. Less extreme examples are found in the careful examinations of plant forms as made by botany and in the observations of animal behavior and animal learning which have proved fruitful in the field of animal psychology.

"*Imagination as a Means of Supplementing Observation.* When science has brought together all the facts which are procurable, the next step frequently is to supplement these facts by the exercise of the imagination. The chemist finds evidence of the existence of particles of matter which are minute beyond the remotest possibilities of vision; he therefore pictures to himself these minute particles and calls them 'atoms.' He goes so far as to make diagrams of the arrangements of the atoms in the different substances with which he deals. He frankly admits that his diagrams are wholly schematic, but they serve the purposes of his science. They are concrete devices for expressing the relations which his experiments lead him to believe must exist in matter.

"There are other directions in which the scientist must use his imagination. The facts which are remote in time can never be observed, but reconstructive imagination can formulate them out of the evidences which past events have left behind. The geologist tells of ice caps and volcanic eruptions; the astronomer reconstructs a universe which was here before the earth was formed.

"The exercise of the imagination in science is an operation which demands training. The scientist is not at liberty to put together his ideas in a capricious and accidental way. The child entertaining himself with fairy stories may imagine without restrictions any combinations of ideas which chance to come into his mind. He constructs a world full of giants and gives his hero unlimited advantages in the conquest of his enemies. The scientist must formulate his ideas with due regard for all the facts which are open to direct observation and must construct his system of ideas so that there shall be complete consistency

throughout. The imagination of the scientist is critical as contrasted with that of the child. . . .

"The next step in scientific procedure after one has observed many facts and supplemented these through the exercise of critical imagination is the formulation of explanations or scientific principles. A scientific explanation is superior to ordinary experience in that it holds together within a single span of attention a group of facts which cannot be kept together unless there is a unifying principle or a recognized central plan running through the whole collection of facts. By way of illustration, we may refer to such a matter as the life history of a plant or animal. Such a history is made up of a long chain of details which are very difficult to remember until the general principles of progressive development and adaptation are clearly apprehended. Then the series of facts becomes intelligible, and contemplation of all the facts, instead of distracting the mind because of the apparent diversity of details, encourages the thinker to note and arrange in proper order all that he observes. . . .

"It is found that pupils in the schools are very little interested in long series of scientific observations. The tax on their attention is too great. Scientific grasp must be cultivated by teaching them to comprehend short series of facts until little by little they can extend attention to the point of holding together the longer series which constitute the broader, more productive themes of scientific thinking.

"*Science as Abstraction and Generalization.* The various processes which have been enumerated as making up scientific thinking involve the two processes which are characteristic of all higher forms of thought, namely, abstraction and generalization. There can be no science without analysis which discovers in complex situations the essential elements and, after locating these elements, stimulates search for the same factors in situations other than those in which these elements were first discovered.

"Abstract thought and generalization are not possible until the mind has passed out of the early and immature stages of learning. It was pointed out in the discussion of mathematics that one must learn not to be distracted by the multitude of

experiences which are presented to the senses if one is to think of geometrical properties or of quantitative relations. One must acquire ability to neglect all but the essential factors. Such concentration on abstract items is facilitated by the use of language, and it is fully mastered only after much training.

"The problem of science-teaching is one of training pupils in analysis and in the selection of significant items. In order that pupils may achieve these highest forms of thought, the materials of instruction must be skillfully arranged so as gradually to lead pupils to the more difficult stages of thinking. The teacher must be patient with immaturity and helpful in inducting the pupil into the difficult processes of thinking. That science-teaching has not been uniformly successful is due to failure on the part of many teachers to understand their problem and to proceed in ways that insure its successful solution.

"*Discovering Problems.* The first requirement which must be met if science instruction is to succeed in inducing true thinking on the part of pupils is the requirement that the pupil be made aware of the fact that there exists a problem which he must try to solve. The pupil will have no interest in the laws of mechanics until he realizes that it is possible to find a regular mode of procedure in the mechanical world. The mistake is sometimes made of believing that scientific interests grow naturally out of practical needs. Indeed, it is sometimes said that the desire to learn how to meet practical problems is the source of all science. There can be no doubt that practical needs are often very useful in arousing a pupil's desire for scientific knowledge, but this fact does not justify the sweeping assertion often made that science grows out of practical needs. We all have needs, but we do not always see in them problems to be attacked by scientific thinking.

"Science did not originate, as was pointed out earlier in this chapter, in deliberate efforts to master nature. Science was at first an attempt to broaden experience. Primitive man had a set of explanations of the world which were very much more elaborate than were his ideas in industrial matters. It is true that he used the stars to guide his ship or his caravan, but his mythology went very much beyond the study of the positions of the stars. His active mind peopled the firmament with grotesque monsters

whose imagined shapes bound together the stars in constellations. To say that early astronomy was a handmaid of the art of navigation is to pervert immeasurably the history of science.

"Again, take the hunting ceremonies of primitive peoples. These peoples depended on game for their food and became most expert in the tracking of animals. Even the modern scientist can learn from his unscientific guide highly interesting and important facts out of which to formulate a science of animal life. This is because the guide has much practical information and uses it in tracking game. He is, however, very often crude and uncritical in his efforts at explanation. When the primitive hunter sits by the fire after the day's hunt, he lets his imagination have free rein. Then the prey which he tracks so skillfully during the day takes on all sorts of personal characteristics and goes through all kinds of unobserved and unobservable performances. The hunter is now a man of imagination. He is cultivating the powers of thought which some day will mature into critical science, but at this stage he is limited by no restraints of mere observation and by no disposition to collect evidence before he enters upon the formulation of theory. The explanations which the primitive hunter gives of animal behavior are derived from his inner world of experience, not from the outer world of fact.

"*Ideas Shape Practice, Not the Reverse.* The presence of practical needs was not the reason why the unrestrained speculations of primitive man were converted into science. Indeed, the history of primitive customs shows exactly the reverse; man shaped his practices to fit his theory. Think of the practices of sacrifice and religious propitiation. Primitive society puts its members through the most onerous tasks to satisfy demands which were wholly of the imagination's making. The history of these practices is to our modern minds the history of irrational acceptance of absurd views about the world. The views back of primitive ceremonies are derived from the fantastic world which man made in his own mind and substituted for the world of his senses. To understand primitive customs one has to study primitive myths. Thought was not controlled by practical adjustments; quite the contrary, behavior was dominated by fantastic imagination. . . .

"Perhaps the best illustration of the fact that science in some cases must be developed as a means of making people aware of

practical needs which exist but are not recognized is to be found in the unintelligent way in which many communities ignore their really urgent need for improvement of sanitary conditions. Savage tribes encountered a great many inconveniences and often suffered from diseases because of the lack of sanitary conditions in their villages. Modern cities in the tropics have frequently suffered seriously because of lack of appreciation of the need of sanitation. Most children have a natural interest in dirt that has to be eradicated by artificial training. In other words, the importance of keeping clean and the importance of sanitary measures have to be learned through a study of the situation. A community has to be persuaded that it has a sanitary problem before it will adopt measures to relieve itself of the inconveniences and dangers that come from ignoring its problem.

"The mistake which high-school teachers of science often make lies in the assumption that pupils are eagerly seeking scientific solutions of urgent problems and that it is only necessary to offer them information in order to insure diligent attention. The fact is that the introduction to science must be carefully planned so as to make pupils understand that there are problems to be solved."

Textbooks Too Abstract. "A fatal difficulty with many science textbooks and with much laboratory work is that the effort of the teacher is devoted entirely to giving the pupils results. Science in its completed form is a statement of solutions of problems. The first step in scientific thinking of the personal type which the pupil ought to take consists in such a recognition of problems that he is led to an appreciation of the reasons why anyone should try to discover scientific explanations. There is nothing more fatal to mental life than the learning of solutions of problems which are wholly artificial to the pupil and not appreciated by him as having any significance either for himself or for society. On the other hand, if one can get a pupil to see that the facts of life ought to arouse his curiosity, a very large part of the difficulty in science-teaching disappears. To be sure, the results of science must be used in arousing the desire for explanations, but the results are not ends in themselves."

Strange versus Familiar Facts. "It is sometimes suggested that science ought to begin with the study of familiar facts. Psychologically, it is very difficult to see a problem in a familiar

fact. It was pointed out in connection with the study of language that it is difficult to get pupils to think about their mother-tongue in any such way as to arouse an interest in the structure of language. It is much simpler to interest a pupil in a foreign language and to induce him through this medium to discuss language from the point of view of its structure and vocabulary. In short, it is the unfamiliar which presents obvious problems. One finds a concession to this natural psychological attitude in some of the supplementary readers on science which are put into the hands of pupils. Remote problems of a type which are utterly unfamiliar to the pupil's ordinary experience are offered in these books as the most stimulating body of material with which to interest the pupil in scientific investigations. Strange plants and animals are described and their modes of life recounted as the means of drawing the attention of the pupil to the fact that plants and animals have peculiarities which need to be studied. One can frequently interest a pupil in mechanical devices by referring to some new and elaborate and, on the whole, mysterious mechanical contrivance. It has been found relatively easy, for example, to interest boys and older people in radio because that is a new invention and difficult to explain and understand. One hardly feels the necessity of interesting oneself particularly in an ordinary telephone because it is familiar. In the history of science it was the remote facts which were first made subjects of careful and repeated observation; familiar facts were never thought of as requiring any special attention. . . .

"On the other hand, a continual diet of strange and wonderful things distorts the pupil's attitude toward science in such an extreme way that there is danger of leaving in his mind the impression that all science deals with strange and remote objects. One of the criticisms of ordinary newspaper science is that it leaves in the popular mind the impression that science is full of extraordinary and mysterious problems and solutions. It would be very difficult to get any newspaper to publish some of the ordinary facts with regard to the atmosphere or with regard to the common principles of mechanics. There is no difficulty in getting a hearing for an account of some remarkable manifestation of atmospheric conditions or a description of a new and doubtful application of mechanics. Indeed, the more doubtful the veracity of the inventor in reporting his invention, the more

likely is his story to get a hearing in the public mind. The teacher in the high school must, therefore, be on his guard not to stimulate the pupil with extravagant and strange material to such an extent that the impression becomes established that science always relates to the remarkable and the remote. The pupil must ultimately be led to see that every object about him has characteristics which ought to arouse his inquiring mind to scientific study.''

[Judd, C. H., *Psychology of Secondary Education* (Ginn and Company, Boston, 1927), pp. 333–350. By permission.]

Professor Dewey presents in the following paragraphs a definition of science which will repay careful study by any student of the subject. In addition he presents his view of the distinction between psychological and logical methods of presentation of subject-matter. While this distinction is here made to apply to the teaching of science, it is implied that it is one which indicates a general principle applicable to all school subjects.

2. PSYCHOLOGICAL VERSUS LOGICAL METHODS

Definition of Science. ''By science is meant, . . . that knowledge which is the outcome of methods of observation, reflection, and testing which are deliberately adopted to secure a settled, assured subject matter. It involves an intelligent and persistent endeavor to revise current beliefs so as to weed out what is erroneous, to add to their accuracy, and, above all, to give them such shape that the dependencies of the various facts upon one another may be as obvious as possible. It is, like all knowledge, an outcome of activity bringing about certain changes in the environment. But in its case, the quality of the resulting knowledge is the controlling factor and not an incident of the activity. Both logically and educationally, science is the perfecting of knowing, its last stage.

''Science, in short, signifies a realization of the logical implications of any knowledge. Logical order is not a form imposed upon what is known; it is the proper form of knowledge as perfected. For it means that the statement of subject matter is of a nature to exhibit to one who understands it the premises from which it follows and the conclusions to which it points. As from

a few bones the competent zoölogist reconstructs an animal; so from the form of a statement in mathematics or physics the specialist in the subject can form an idea of the system of truths in which it has its place."

Logical Form of Science a Stumbling Block to the Immature. "To the non-expert, however, this perfected form is a stumbling block. Just because the material is stated with reference to the furtherance of knowledge as an end in itself, its connections with the material of everyday life are hidden. To the layman the bones are a mere curiosity. Until he had mastered the principles of zoölogy, his efforts to make anything out of them would be random and blind. From the standpoint of the learner scientific form is an ideal to be achieved, not a starting point from which to set out. It is, nevertheless, a frequent practice to start in instruction with the rudiments of science somewhat simplified. The necessary consequence is an isolation of science from significant experience. The pupil learns symbols without the key to their meaning. He acquires a technical body of information without ability to trace its connections with the objects and operations with which he is familiar—often he acquires simply a peculiar vocabulary.

"There is a strong temptation to assume that presenting subject matter in its perfected form provides a royal road to learning. What more natural than to suppose that the immature can be saved time and energy, and be protected from needless error by commencing where competent inquirers have left off? The outcome is written large in the history of education. Pupils begin their study of science with texts in which the subject is organized into topics according to the order of the specialist. Technical concepts, with their definitions, are introduced at the outset. Laws are introduced at a very early stage, with at best a few indications of the way in which they were arrived at. The pupils learn a 'science' instead of learning the scientific way of treating the familiar material of ordinary experience. The method of the advanced student dominates college teaching; the approach of the college is transferred into the high school, and so down the line, with such omissions as may make the subject easier."

The Psychological Method. "The chronological method which begins with the experience of the learner and develops from

that the proper modes of scientific treatment is often called the 'psychological' method in distinction from the logical method of the expert or specialist. The apparent loss of time involved is more than made up for by the superior understanding and vital interest secured. What the pupil learns he at least understands. Moreover by following, in connection with problems selected from the material of ordinary acquaintance, the methods by which scientific men have reached their perfected knowledge, he gains independent power to deal with material within his range, and avoids the mental confusion and intellectual distaste attendant upon studying matter whose meaning is only symbolic. Since the mass of pupils are never going to become scientific specialists, it is much more important that they should get some insight into what scientific method means than that they should copy at long range and second hand the results which scientific men have reached. Students will not go so far, perhaps, in the 'ground covered,' but they will be sure and intelligent as far as they do go. And it is safe to say that the few who go on to be scientific experts will have a better preparation than if they had been swamped with a large mass of purely technical and symbolically stated information. In fact, those who do become successful men of science are those who by their own power manage to avoid the pitfalls of a traditional scholastic introduction into it.

"The contrast between the expectations of the men who a generation or two ago strove, against great odds, to secure a place for science in education, and the result generally achieved is painful. Herbert Spencer, inquiring what knowledge is of most worth, concluded that from all points of view scientific knowledge is most valuable. But his argument unconsciously assumed that scientific knowledge could be communicated in a ready-made form. Passing over the methods by which the subject matter of our ordinary activities is transmuted into scientific form, it ignored the method by which alone science is science. Instruction has too often proceeded upon an analogous plan. But there is no magic attached to material stated in technically correct scientific form. When learned in this condition it remains a body of inert information. Moreover its form of statement removes it further from fruitful contact with everyday experiences than does the mode of statement proper to literature. Neverthe-

less that the claims made for instruction in science were unjustifiable does not follow. For material so taught is not science to the pupil."

Technical Manipulation Not a Proper Aim. "Contact with things and laboratory exercises, while a great improvement upon textbooks arranged upon the deductive plan, do not of themselves suffice to meet the need. While they are an indispensable portion of scientific method, they do not as a matter of course constitute scientific method. Physical materials may be manipulated with scientific apparatus, but the materials may be disassociated in themselves and in the ways in which they are handled, from the materials and processes used out of school. The problems dealt with may be only problems of science: problems, that is, which would occur to one already initiated in the science of the subject. Our attention may be devoted to getting skill in technical manipulation without reference to the connection of laboratory exercises with a problem belonging to subject matter. There is sometimes a ritual of laboratory instruction as well as of heathen religion."

[Dewey, John, *Democracy and Education* (The Macmillan Company, New York, 1916), pp. 256–259. By permission.]

As stated in the last selection, science is knowledge, made as certain as it can be made by reflective thinking, including those special methods of thought, observation, experiment, etc. which are sometimes referred to as scientific method. All writers on the subject are agreed that one of the greatest difficulties in the teaching of science is to arouse the problem-solving attitude on the part of the student. In the selection about to be presented, we have an analysis of the various forms which curiosity may take and suggestions as to how this questioning attitude may be fostered. Here again, we find that these suggestions, while they are primarily applied to the teaching of science, have general significance.

3. NAÏVE QUESTIONS AND SCIENCE TEACHING

Lack of Curiosity in Pupils. "The dual purpose of the teaching of all subjects, especially of science, is to furnish worth-while subject-matter and a method for future independent work. When the method of the scientist is analyzed, its beginning is found al-

ways to be in an alertness of mind about objective phenomena that results in questions. It is in just this detail that education seems lamentably to fail. Hundreds of adults are found to have a more or less satisfactory knowledge of facts, scores are industrious at set tasks even though they may be meaningless, dozens understand principles in a general way, and one is keen to see things for himself, find problems, and analyze them suitably by selecting from the questions that his brain invents. Science teachers have frequently commented on the paucity and irrelevance of the questions asked by pupils on field trips, and research professors rejoice at the rare student who finds and analyzes his own problem, demanding from them only opportunity, time, encouragement, and direction for its solution. This paper purposes to consider the naïve questions of adults when confronted with a novel situation, in the belief that they will throw some light on the causes of mental passivity or of dependent industry.

"Thorndike has shown that habits are formed in the lowest animal life to the highest by action, either chance or intentional, being followed by satisfaction. The 'satisfier' may be a bodily need or, in the case of *homo sapiens,* more frequently to an intellectual need for an answer to an enquiry. In varying degrees man is uncomfortable if he does not know what his companions know, or if he cannot find answers to the questions that spontaneously rise in his mind. It is desirable in planning economical instruction to know what sorts of naïve questions the human mind frames and to consider if they fall into any kind of orderly category."

Testing Curiosity in Adults. "Some ten years ago, interested in this problem, I began to test in an informal way the adults with whom I came into frequent contact. In this testing, which has been continued from time to time ever since, I have used a number of novel objects, but have had most success with a unique substitute for a back collar button, a small piece of metal doubly curved so that one end would catch under the shirt band to prevent the collar's 'riding' and the other would hold out a turn-over collar so that the necktie would slip easily; a circular slide rule; and a 'Lock-Tite' tobacco pouch, which has since the experiment become commonly known. The method was to present the object to an acquaintance, a fellow teacher or a graduate student of education, and to note the questions that he asked or that he betrayed by

his actions. It very soon seemed clear that the reactions were of especial importance to the method of science teaching. Gradually the questions fell into a hierarchy, which will be presented presently; and although no detailed account of each kind was kept, it is clear that the frequency decreases in a sharply descending curve from the first type of question to the last.''

The Reasons for Questions. ''Nothing is more noticeable than the variation in intensity of interest aroused by the casually presented and novel objective phenomenon. A few subjects turned it over for a moment and politely handed it back with, ''What did you give me this for?' Others asked one or more questions, some with a dependence encouraged by years of being poorly taught seeking the answers from the experimenter, others demanding the satisfaction of independent discovery. The number and kind of questions seemed to result from any one of several causes. The first cause of all is a mental alertness, a desire to know, the annoyance of being ignorant. This attitude is in some individuals strong only in the field of their particular interests; in others it is general, resulting in a breadth of information and a closely related and consequent culture. What an improved race of intellectuals we should have if this general curiosity could be made common!

''A second cause of questions is a perceived relation between the object or the experiment and oneself. In rare instances the subject being highly self-conscious refused to express or reveal his naïve questions, apparently fearful that he might betray some discreditable intellectual weakness. Perhaps this attitude, too, was the result of unhappy experiences as a pupil under an unsympathetic and caustic instructor. Usually, however, if the subject perceived or could be made to perceive some relation between the phenomenon and himself, his questions were multiplied and he persisted in his enquiry to satisfactory answers.

''In one instance it was interesting to note the results of a combination of the two causes mentioned. A man keen of intellect and ingenious with mechanics was handed the tobacco pouch. Having quickly answered the simpler questions, he was puzzled to find an explanation of the principle involved, which both his habit of questioning and his former experiences demanded. Three times defeated he laid the problem aside as not worth his time, and three times his intellectual curiosity and his annoyance at

being baffled drove him back to achieve success. This habit of persistence yoked with the habit of enquiry goes a long way toward making the scientific attitude. It is most likely to result if 'satisfiers' can be assured to naïve questions from early years, for 'satisfiers' develop habits and 'annoyers' inhibit them.

"A third cause of lively interest and resulting questions is an active phenomenon. At every exhibition spectators are found crowded around a spark plug in which a spark is leaping or a hutch of rabbits nibbling their food, while the silent engine or the stuffed monkey draws only those who have already a developed curiosity. In my experiments an unfailing stimulus to interest was the rotating of the slide rule or the unlocking of the tobacco pouch. Every science teacher has noted the greater effectiveness of showing a moving amœba or a machine at work rather than a stained specimen or a machine at rest. The suggestion is strong that in the classroom interest should be stimulated whenever possible by exhibiting in action the object to be studied."

The Kinds of Questions Most Frequently Asked. "In the hierarchy of questions the simplest and by far the most frequent is: 'What is it?' or 'What is it for?' An answer explanatory of the function, like 'Tobacco pouch,' satisfies both questions, but it was astounding to find that in many instances a technical name meaningless to the layman leaves him content. But we find a similar situation in some science teaching; the pupil learns that something is called *Agaricus campestris, Toxostoma rufum,* cam, cathode, or hormone, and then such curiosity as may be had subsides. The satisfaction doubtless lies in the comfort of knowing something that others about one know and in a sort of intellectual snobbery that permits gloating over the ignorant. Stopping at this point results in the superficiality revealed when inquiry is made as to exactly what these things are and how they function. Ask a half dozen acquaintances just how we get electric lights or what fermentation is, and the answers would be amusing if they were not such pathetic commentaries on the way some schools teach or most adults forget.

"The satisfaction or the pride in the knowledge of mere names, which it must be admitted often passes as current coin in polite society, is valuable in the science class only as a basis for building up interests in higher types. Beginning here, the wise teacher permits, encourages, and assures satisfying answers to all sorts of

questions. However foolish or irrelevant they may be, some satisfaction, much privately given, must be provided or else the young pupil first fails to voice his questions and finally ceases to raise them definitely even to himself. In a college biology class the professor provided the students with specimens for the microscope and bade them observe; but lacking definitely formulated questions they wasted precious laboratory hours and learned little. The professor was conscious of the higher types of questions that he desired the students to find answers for, but they were not. They acquired little of information and less of method because they were not permitted, encouraged, and directed to use the method natural to human learning: the formulation of a problem, an appreciation of its worth, and then an attempt at solution. Some teachers at early stages encourage the timid in the formulation of definite enquiries by a question box; others are able to develop directly the habit of asking for information. But clear and definite questions beyond 'What is it?' are necessary if worthy and economical learning of subject-matter and of method is likely to follow. Voiced curiosity in one student stimulates enquiry in others, partly by suggestion and partly by the abhorrence each Ego has of not being informed equally with its fellows.

"The second question in the hierarchy, second lowest in frequency and highest in importance, is 'How does it work?' or 'How is it used?' Almost invariably when the unique collar button, the circular slide rule, or the tobacco pouch was shown, this was the naïve question that followed enquiry as to what the object was. This clearly shows a higher level of interest, and its answers are of greater worth. As a matter of fact, probably a majority of pupils who take first-year science in high school will find a knowledge of what things are and how they work amply satisfactory in life. Higher questions are raised only on higher levels of intelligence. A class that is passive and patient under explanations of principle will be eager to observe an amœba ingest a particle of food or even to watch an instructor set a piece of apparatus to work with an explanation of what it is used for. It is quite possible that in the hope of developing 'real scientists' of all pupils teachers with their optimism have failed to appreciate the importance of the answers to this type of question. Adequate for many, they are for all basic to advanced learning.

"The third question, if interest persisted so far, was, 'Can I

work it?' Often it was expressed by a reaching for the object and a turning of the dial or a pulling of the pilot tag. There is here, as in the first question but stronger, a tacit egocentricity. It results in the satisfaction of the instincts for being a cause for activity. These instincts are obvious when watching a person attempt to untie a difficult knot; one can hardly restrain himself from making the attempt. At the Atlanta Exposition the most popular feature in one of the government exhibits was an instrument that would show simple moving pictures when an individual turned a crank. The pictures were merely of a postman performing his routine duties; so obviously the attractiveness of the exhibit was due to the fact that each person could 'be a cause' and make the instrument work. I have seen a science class grow lethargic while the instructor did for their edification what they themselves could just as well have done and what for a few minutes each pupil instinctively desired to do. Of little value except as causes, the instincts have manifested the means of arousing other interests and leading on to higher mental activities. It is obvious that so far as feasible pupils should be permitted to touch, move, and 'monkey with' specimens, instruments, and machines. In his *Animal Intelligence* Thorndike makes it clear that primates learn fast because of their persistent instinct to do just these things; and there is a good deal in common in the learning by lower animals and by the most intellectual of us. When pupils 'fool with' specimens and machines, or set up apparatus and use it as they will they develop an interest, they learn a good deal (witness the boy and his wireless set), and best of all they raise for themselves innumerable questions. It is the wise and the highly successful teacher who can without discouragement or undue repression satisfy these questions so that the habit of raising them is established and at the same time lead the pupils to recognize the value of the more important ones in leading toward a commonly desired goal.

"The question fourth in order is, 'What makes it work?' or 'What is the principle involved?' Although often and unwisely the beginning of science instruction and inevitable somewhere in every topic for secondary and higher schools, this question is not frequently raised by intelligent and well educated adults when informally confronted by simple, novel objective phenomena. My subjects were for the most part content to know that the

queer object is called a slide rule, that it is used, among other things, in the rapid computation of percentages, that it is operated by turning the dial thus and so, and that they themselves can find answers with it; very, very few asked or seemed interested in the underlying principle, though none of those who were asked could explain it. A slightly larger per cent were interested in the principle of locking the tobacco pouch. In other words, science had not been successful either in high school or in college with these superior adults in its attempt to inculcate the habit of demanding the principle involved. It is not unreasonable to suspect that the cause of this indifference lies partly in the emphasis on principle before the earlier questions in the hierarchy had been satisfied and partly in the failure to encourage naïve questions by providing satisfactory answers to those raised whether they were the ones anticipated and desired by the instructor or not. If there were more generally employed the collecting instinct, especially in the junior high school period, and the instinct of rivalry to accumulate or consider more specimens than anyone else in the class, the later interest in underlying principle should reasonably be greater."

Applications to Science Teaching. "Science teachers always go to the fourth step in the hierarchy and expect their pupils to take it also, but how few go on to ask the last and highest question, 'What extensions of this principle are possible?' This is the field of the inventor. In my experiments no one expressed this question concerning the collar button substitute, perhaps because the principle has a unique application, or about the circular slide rule, though the principle can easily be extended to several new phases of educational measurements; but three men proposed, each to satisfy a need of his own, the extension of the locking device on the tobacco pouch to a sleeping bag, to military leggings, and to a football lacing. To a layman it seems desirable that pupils should recognize that this highest type of enquiry exists and should be frequently considered. That they may have the satisfaction of success, situations should be prepared that lead to easy rediscovery of extensions of a principle. This will result in some appreciation of the work of the inventor and it will lead to a satisfaction which may encourage future independent attempts. The average teacher can hardly do more.

"It is quite possible that any observations of the naïve ques-

tions of educated adults may differ from those of immature pupils. But the results are at least suggestive of a method that can be followed by anyone who is interested. If the five types of naïve questions reported or other similar ones are found to be common among secondary school pupils and to form a hierarchy, they will afford valuable suggestions to teachers of the order in which phenomena may be considered in science classes to insure the economical acquisition of information and of methods of procedure. Whenever possible, the habits of nature should be followed rather than combated.''

[Briggs, Thomas H., *Naïve Questions and Science Teaching,* "School Science and Mathematics," 1923, pp. 34–40. By permission.]

QUESTIONS

1. What is a hypothesis, psychologically considered?
2. What is the relation of observation to a hypothesis?
3. What are the three types of mental activity that the pupil may take in reading a scientific principle?
4. What are the psychological advantages of laboratory methods over mere textbook methods in teaching science?
5. What is the function of imagination in science?
6. Show the meaning of the terms *analysis, abstraction,* and *generalization* as they apply to science.
7. Does Judd's advocacy of the use of novel experiences in science teaching imply contradiction of the principle "from the known to the unknown"?
8. How may hypotheses be tested?
9. What is the fallacy of abstract presentation of the subject-matter of science?
10. How does Dewey define science?
11. Compare Dewey's criticism of logical methods in science with Judd's statements concerning urgency of problems. Are these authors in opposition at this point?
12. What various forms of curiosity may be cultivated in connection with science teaching?

CHAPTER XXII

MATHEMATICS

Among the methods used by Professor Judd in his *Psychology of Secondary Education* is that of analysis of textbooks on the teaching of the various high-school subjects. In the next selection there is presented a typical illustration of this method as applied to a well-known book on the teaching of mathematics.

1. PSYCHOLOGICAL ANALYSIS OF A TEXTBOOK

"The effort to understand what is going on in the minds of pupils when they attempt to master the subjects which they study is by no means new. Such attention to the mental processes of pupils did not originate with educational psychology. Every textbook prepared by an experienced teacher embodies conclusions reached through contacts with many minds. Every method and device employed in the classroom implies a view with regard to the way in which pupils think and with regard to the way in which they should think. Every book on methods written for the guidance of teachers is filled with generalizations about pupils' mental processes.

"The student of psychology accordingly finds in the practices of the school and in the pronouncements of writers on methods stimulating suggestions which he can use in the development of his science. . . .

"*Schultze on Memory.* Schultze, writing on the methods of teaching mathematics in the high school, makes the following comments on important psychological matters:

" 'In * the preceding paragraph it was pointed out that mechanical memorizing is a perfectly proper method of studying the most elementary, the most fundamental facts, which are of frequent application. This is possibly the reason why the teach-

* Schultze, Arthur, *Teaching of Mathematics in Secondary Schools.* By permission of The Macmillan Company.

ing is far more effective in the lower grades than later on. In more advanced work the very nature of the subjects makes mere memorizing ineffective.

"'Our high schools, however, not only encourage memorizing, but sometimes almost force the student to adopt this as the only mode of study, for only by memorizing can he hope to satisfy the immediate demands of the school.

"'The daily rations of mental food that the student has to swallow give him no choice; there is no time for thought, for meditation, for judicious study; he *must* memorize. Moreover, the character of the studies leads him to mechanical work, for, in spite of the vigorous denials of our pedagogues, the greater part of the curriculum is informational. It is knowledge and not power that is emphasized in most of the studies, and even subjects which by their very nature should be mastered by thinking are often made informational. For the informational method produces much quicker and more spectacular results than the slow judicious mode of study. What a fine display of learning students can make if they have been craming conscientiously! How high the percentage they can secure in examinations! True, the after effects are sad, but who cares? As long as the boy can talk glibly about complex economic problems in terms which he does not understand, we are satisfied. What does it matter that a year later he has not the remotest inkling of the subject, that he cannot discuss intelligently the simplest new problem that may arise!

"'Can we wonder that under such conditions the student never breaks away from his mechanical way of studying that he acquired in the elementary school? And can we wonder, too, that the results of our teaching become inferior in the higher grades of the grammar school, and especially so in the high school?'* . . .

"It is evident that Schultze thinks of memorizing as a relatively low form of mental activity. It is evident also that he thinks of the high schools as a place where higher mental processes should be in the ascendancy.

"Would teachers in the elementary school accept the foregoing description of their methods? How far is 'mere memorizing'

* Arthur Schultze, *The Teaching of Mathematics in Secondary Schools* (The Macmillan Company, 1912), pp. 10–11.

to be distinguished from other and possibly virtuous forms of memorizing? Is it proper to characterize any mental process as 'mechanical'? If so, what is the exact meaning of the word when so used? What are some of the higher mental processes that the high school should emphasize? These and like questions arise in the mind of the psychologist who reads the passage quoted.

"*Memory Essential to Learning.* Any psychological discussion of memorizing must begin by pointing out with emphasis the fact that memory is essential to all learning. Memory is defined by psychology as the power to retain experience and to recall that which is retained. When a high-school pupil studies a proposition in geometry and afterward gives evidence that he has retained the results of his study, he is exhibiting what is known as 'memory.' Broadly speaking, we may say that memory is one of the most important of the powers of the mind, for without it there could be no accumulation of ideas.

"*Simple Types of Memory.* Ideas may, however, be retained in various ways. Suppose the proposition in geometry which the pupil is trying to retain contains several assertions which the pupil does not understand. Suppose that the pupil, in order to be able to recite on these obscure items, says them to himself several times until the sequence of the words and symbols used in the book is fixed in his mind in the exact form in which the original items were given. He would in this case be resorting to memory of a very special type. When retained as mere sequences of words, the items of experience follow one another in the pupil's mind with no other link of connection than that established by the succession of verbal symbols. The memory which the pupil has in such a case is of the type which one has when remembering a series of nonsense syllables. It is memory of certain sounds or visual images and articulation sequences.

"*Individual Differences in Memory.* Even in the relatively simple kind of memory described in the foregoing paragraph there are marked individual differences. One person depends on visualization or the power to call to mind vivid visual pictures of words, while another depends on sound images or muscular images. There are some people who are very quick in acquiring trains of ideas of the type described and are readily able to reproduce them when required to do so. There are other people

who are relatively slow in acquiring such trains of ideas and are uncertain in reproducing them.

"*Forgetting.* There are other facts about the simple types of memory which are of importance to the educator. The items of experience which are remembered in these simple ways can be reproduced if they are called for very soon after they are learned, but they quickly drop out of memory; that is, they are forgotten because there is no strong interest in their retention. There are so few lines of association in the learner's mind that the items are not tenaciously retained or recalled.

"*Complex Forms of Memory.* In contrast with the form of memory which has been referred to up to this point, there are other forms involving a larger number of associations of ideas. The pupil who understands fully a demonstration in geometry acquires a number of associations which do not appear at all in pure verbal memory. The very process of understanding stimulates him to connect with the present experience other experiences of a similar type, and the whole situation is carried forward by the individual as a part of his broader mental equipment. It must not be overlooked, however, that even here the mental process is emphatically a case of memorizing.

"*Educational Significance of . . . Different Types of Memory.* Distinctions between different types of memorizing are essential if one is to agree with Schultze in his condemnation of memory. His attention seems to be concentrated wholly on the lower and less desirable forms of memory; he does not tell us how utterly dependent the teacher is for progress on the higher and more desirable forms of memory.

"Let us see whether we can elaborate somewhat the statement of Schultze and point out what mechanical memory is and the psychological reason why this type of mental activity is to be avoided.

"*Verbal Memory.* If someone gives the pupil a series of words to repeat, or a formula to follow, and the whole process passes through the pupil's mind merely as a succession of symbols to be imitated without deviation from the pattern set and without any clear understanding of what is meant by the symbols, the pupil may be said to be entirely absorbed in mere names of ideas and to have none of the ideas to which these names refer. Some-

one had ideas when the formula was invented; someone thought out the relations involved; but the original effort is not repeated by the pupil because the results of the earlier thinking rather than the processes of thought themselves are what the pupil has in his mind.

"The writer of a textbook or the teacher who gives a model demonstration intends to facilitate the pupil's thinking by supplying a guide to carry the pupil forward without the delay that would be entailed if each person had to solve for himself the problems under discussion. The facilitation thus aimed at is made possible by the fact that human beings are in possession of language and can help one another's mental processes through verbal communication. The teacher certainly intends no harm to the pupil in adopting the verbal method of facilitating thought and understanding. Facilitation, however, sometimes goes so far that the pupil does not exert himself at all. Schultze has become aware of the possibility of such overfacilitation. He attributes the misuse of aids by pupils to examinations and marks and to the rate at which the school attempts to carry forward the course. He attributes the fact that pupils misuse facilitation to the habits acquired in the school below the one in which he is interested. No one can read these explanations of the fact that pupils go wrong in their mental lives without feeling the need of a more adequate analysis. Examinations and heavy programs and help from teachers cannot be unqualified evils, because they help some pupils. They hinder intellectual progress only when they substitute a too easy reproduction of words for the more arduous understanding of principles. The fault is not in the process of memory but in the absence of understanding.

"What is needed by such writers as Schultze is a more detailed psychological analysis of what goes on in the minds of pupils in order to determine what happens when facilitation, which is intended to aid and direct thinking, is misused and the pupil is injured.

"We are undoubtedly in the presence of one of the most difficult problems confronting the teacher when we try to determine how to transmit to the pupil the accumulated experience of the race without overwhelming him. How to give the pupil guidance without making him utterly dependent, how to use words without

allowing them to absorb the pupil's whole attention, how to furnish a model without making acquaintance with the model the end of the pupil's efforts—these are the problems which every teacher must try to solve. If the pupil can be guided in his thinking, his progress will be rapid and in the right direction; if he merely follows in the footsteps of his teacher, his thinking will be formal and of the type which Schultze calls 'mechanical.'

"*Limitations of Formal Learning.* Our psychological analysis must go a step farther than mere description of what happens when a pupil falls into intellectual formalism. We must ask why formalism is evil. The answer to this last question is supplied by the statement that the pupil who merely follows the formulas presented by someone else has no control over these formulas; that is, he can reproduce them only under conditions similar to those under which they were given to him by the textbook or the teacher. He cannot see beyond the formula; he is not able to extract the principle involved and to use it when he encounters a wholly new situation. A pupil who learns a proposition out of a textbook in geometry but fails to understand the principle involved will not be able to demonstrate the truth of the proposition if the figure is slightly changed. For the same reason, he will not be able to use the principle at a later time when it applies to a part of some new complicated figure. We are prepared by the discussions of the last chapter to restate in true psychological terms the danger in the type of learning which Schultze condemns. The pupil memorizes but does not think abstractly. He does not generalize. He reproduces that which comes into his experience in the form in which he receives it; that is, his experience remains at a low level—the level of immediate recognition of a directly given fact. The pupil's mind is dominated by what comes to his senses rather than by his own thought reactions. He cultivates no insight.

"*Use without Understanding.* The danger of formalism of the kind which has been discussed increases as civilization becomes more complex and as its devices are perfected. What is happening in the mental world has its direct analogue in the world of mechanical contrivances. Many a modern individual is able to use a piece of mechanism, such as a telephone or an automobile,

but is utterly unacquainted with the principles involved in its construction. In both these cases someone other than the user perfected the mechanisms and transmitted them to the user. The mechanisms involved much thought for their construction, but the user receives, without intelligent comprehension, the results and advantages of the thinking and experimenting that went into the construction. The user takes over the finished product, and, so long as the conditions of use are simple, all goes well.

"So it is also with social institutions, which are embodiments of the thought and intellectual experimentation of earlier generations. As pointed out in an earlier chapter, the number system is a creation of the race, and it is so highly perfected that it can be used by anyone who will follow certain fixed rules. The user does not need to know the fundamental principles which went into the making of the system of number so long as the problems to which numbers are applied are simple and familiar in type.

"It is interesting to ask how far teachers are justified in teaching ways of solving problems by the easy method of merely accepting what the race has accumulated and how far it is their duty to demand that pupils understand fundamental principles. The question may be put in a practical form as follows: A clerk in a store which has installed a cash register can be trained to record each purchase by pushing down easily recognized stops. The machine records each purchase and adds items so that at the end of the day the total is shown. How far is it desirable for the clerk to understand the mechanism of the cash register, and how far should he be asked to master the principles of bookkeeping involved in balancing accounts at the end of the day? The answer seems to be somewhat as follows: So long as the mechanism is in good running order and so long as the clerk continues at his present level of occupation, he will need nothing more than the ability to push down the right stops. Civilization has produced a mechanism for reducing to a minimum the clerk's mental efforts in recording purchases. The mechanism is advantageous in so far as it releases the mind for other kinds of work and disadvantageous if it trains the user in habits of mental laziness.

"There is a genuine danger for human beings in the fact that the mind released from work by the devices of civilization will grow torpid and will make no good use of the leisure gained. In

fact, it is entirely conceivable that a mind on which no exacting demands are made may atrophy and thus be more damaged than helped by civilization.

"A perfect textbook, a rigid adherence to routine in the recitation, and an absence of any demand that the pupil use what he has learned anywhere except in the classroom will reduce algebra and geometry to the level of the cash register. The mathematical sciences, like the mechanical device, are products of social invention. They can be operated up to a certain point by anyone. Thus, one can determine the area of a circle by a formula; one can extract a square root by following a rule; one can find the third term of a geometrical series without any real interest in the process and without insight into its import. . . .

"On the other hand, if one has followed a few typical demonstrations and has understood them, if one has mastered a few fundamental principles, one acquires the power to use the intellectual methods of the race and to carry on higher forms of thinking. This case is analogous to that in which a skilled mechanic learns how to use a particular implement, and, through this use and through his acquaintance with the principles of construction involved in the making of the tool, enlarges his general knowledge of mechanics. The intelligent and highly trained mechanic has both the products of civilization and a mastery of the ideas which entered into the creation of these products. This higher knowledge gives him a power which mere use does not afford. He who knows the principles of mechanical construction has a superior type of knowledge.

"Complete education has not been attained until the individual has acquired both mastery of the common devices of civilization and a sufficient knowledge of the methods which have been used in constructing these devices to make him superior to particular conditions. How far can every member of the community have a complete education. How far can an individual attain a complete education in different spheres of experience? America is engaged in the experiment of trying to raise the masses to the level where everyone shall have, at least in some limited field, more than a purely practical knowledge. One must be able to use weights and measures whether one understands the principle of the balance or not. One must be able to communicate with one's neighbors even if the study of the structure of English sentences is left out

of one's education. Our educational creed in this country is that as many people as possible shall understand weights and measures as well as use them and shall understand the structure of English sentences as well as use them. In our efforts to realize the general training of the masses, we are requiring algebra and geometry and other scientific courses of a greater proportion of the population than has ever been introduced to these bodies of knowledge in any other country or in any other age. The result of our effort to make as general as possible a full comprehension of the fundamental principles in many different fields has been a type of intellectual congestion which is baffling. There is a very real competition for the pupil's attention. The school program offers a great many opportunities. The pupil cannot accept all of them. Shall he be satisfied to adopt a primitive attitude toward mathematics in order to gain time and energy for other forms of intellectual effort, or shall he concentrate on mathematics, accepting the dictum of most schools that mathematics must be mastered by everyone who would share in the higher intellectual life?

"*High School Education and Intellectual Mastery.* Higher education is organized for the purpose of giving pupils insights. Ability to use numbers as necessary instruments of civilized life is usually acquired by the time the pupil comes to the high school, at least in sufficient measure to meet ordinary demands. Whatever justification there may be in elementary arithmetic for a simpler type of treatment of mathematical ideas, there is no justification in algebra and geometry for mere mastery of formulas and repetition of textbook demonstrations. It should be kept in mind that even the elementary school is not satisfied to do its work in such a way as to cultivate only the lower forms of memory. There is much genuine training in some of the simpler forms of generalization even in the lower grades. The duty of higher education is to conserve all that has been achieved in the lower school and constantly to direct the pupil's attention to higher forms of generalized or scientific thinking. If one accepts this formula, a serious question arises whether a majority of the population should study algebra and geometry. Many writers on education are advocating the elimination of algebra and geometry as required subjects.

"*Schultze on Imagery.* Turning from the discussion suggested by Schultze's condemnation of memorizing, we find in his book a reference to another psychological matter which we may properly consider at this point. Schultze's statements are as follows:

" 'The * study of solid geometry strengthens the student's space imagination and his power to image space configurations, and it gives him an understanding for drawings that represent special objects.

" 'Altogether it seems that the utilitarian advantages are somewhat greater, but the purely cultural advantages somewhat smaller, than in plane geometry.

" 'With such restrictions the study of solid geometry will not offer great difficulty to the student. It may require a little more time and a little more study, but it does not require more intelligence than does plane geometry.

" 'One difficulty, however, against which we must guard and which we must overcome at the very start is the inability of some students to understand diagrams of solids. There are students who are able to reason logically, but who cannot imagine clearly the spatial forms which the diagrams represent. There are two ways of overcoming this difficulty, namely, the use of models and rational methods of drawing.

" 'The function of the model is to help the student in the beginning to an understanding of solid figures in general, and to make clear to him, later on, difficult drawings which otherwise he would not understand. The model should, however, not be used to supplant the drawing. As soon as the student is able to understand the drawings, the models should be discarded or reserved for the most difficult cases only. Otherwise the student will lose one of the main benefits of the study, namely, the development of his space imagination and of his faculty to understand diagrams of solids.' *

"*Images and Education.* Two interesting psychological problems are suggested by the foregoing paragraphs. The first is the general problem of the nature of mental imagery; the second is the problem of the relation of imagery to logical reasoning.

"Schultze has made a number of assertions about images.

* Arthur Schultze, *The Teaching of Mathematics in Secondary Schools* (The Macmillan Company, 1912), pp. 266–268.

There are different kinds of images, some of which are easier to cultivate than are others. Images are capable of improvement. If the methods of the school are appropriate, improvement will take place. If the methods of the school are defective, imagery will be of an unsatisfactory type.

"Such assertions as these make it clear that the teacher should not assume that the space ideas of the pupil are acquired merely by looking at objects and drawings. There is, in general, a neglect of space percepts in the schools, it being assumed that such percepts take care of themselves. The present writer has heard the statement made by a college teacher of solid geometry that students in his classes not only are deficient in their ability to interpret the figures in the text but have been so completely untrained throughout their school careers in the recognition of figures and in the formation of correct images that it is quite impossible at the college level to overcome the handicap.

"The formation of a correct and adequate image is a positive process, requiring concentration of attention and the cultivation of a special kind of intellectual power. It is thus seen that even the first step in the study of geometry, namely, the acquisition of direct acquaintance with the figures to be analyzed, calls for mental effort on the part of the pupil and intelligent guidance on the part of the teacher. . . .

"One of the most commonly employed and effective methods of improving imagery is to require the pupil to draw the figure to be imaged. Drawing necessarily involves a series of analytical steps. Each line must be produced by itself and therefore calls for particular attention and recognition. Thus, drawing contributes to the intellectual analysis which is essential to accurate and detailed imagery.

"Drawing will not give to a flat figure the interpretation of solidity which is essential to the study of solid geometry. To analysis of the figure must be added a projection of the lines into the third dimension, which calls for the exercise of an inner power of interpretation of what is seen. The inner power which is here required is called 'imagination.' Imagination takes elements of experience which are presented to the senses and assembles them in relations which are different from those suggested by the images presented to the eyes.

"Schultze makes the point that, unless pupils are compelled to cultivate active imagination by the withdrawal of models, they will never be able to put themselves in possession of the materials of thought with which solid geometry deals.

"*Necessity of Specific Teaching.* The second psychological assertion contained in the paragraphs quoted from Schultze is that some pupils have more ability to reason logically than to form proper images.

"The importance of such an assertion as this for the teacher of mathematics lies in the necessity of so directing the instruction given in the class that it shall meet the specific needs of pupils. Many class exercises in geometry and in other subjects are conducted as though only one kind of mental activity were to be trained. Perhaps it would be more accurate to say that many class exercises are conducted without any consideration of the mental processes involved on the part of the pupils. When Schultze draws the contrast which he does, he points out that the teacher should not on all occasions direct instruction to the improvement of logical thinking. There are times when mental imagery is to be cultivated. There are other occasions when logical processes are the important matters.

"From this discussion we may derive a general statement with regard to the relation of educational psychology to the work of the teacher. Methods of teaching must vary in accordance with the special type of intellectual power which is to be cultivated. Intelligent teachers have always found it necessary to use various methods in order to be successful in their work. Psychology furnishes the explanation and justification for what experienced teachers have always done and supplies those analytical insights into the mental processes of pupils which will help teachers further to differentiate and direct their dealings with pupils."

[Judd, C. H., *Psychology of Secondary Education* (Ginn and Company, Boston, 1927), pp. 100–115. By permission.]

The teacher of mathematics may easily be satisfied with being able to teach the pupil certain skills or manipulative principles. Professor Lytle, who taught mathematics for many years, writes in the following article, the results of some of his psychological

observation. It will be of value for the student to relate Professor Lytle's views to those expressed by Professor Judd in Chapter XIII.

2. GENERALIZATION

Generalization Defined. "Generalization as a principle of teaching mathematics is often neglected. We are not thinking here of generalization as simply a process of passing from particulars to generals; rather we wish to consider that attitude of mind which continually gives attention to the relations and significance of facts. Learning is a continuous process, a growth, a development, a passing from one thing to something else. In the process of learning there must be concrete particulars; these particulars are the means to intellectual growth and form the material of which knowledge is made. But so long as they remain just isolated particulars they are of little value, they are mere excitations and possible irritations. To be of value these particulars must be related, organized, given meaning and significance. The mere encyclopædic collection of facts is not our conception of valuable learning; rather it is the interpreting and application of facts, the relation and organization of facts, the careful study of the meaning and significance of particulars which rounds out and carries forward the learning process. This continual seeking for significance and organization is generalization."

Generalization Makes Knowledge Useful. "To be useful knowledge should be generalized. Helen M. Walker gives a fine illustration of the principle of generalization. The head of an English department was visiting a geometry class to study the language difficulties of the pupils. She heard a lad sum up the results of a demonstration thus: 'Therefore * if a triangle has AB equal BC, then angle A is equal to angle C.' The geometry teacher pointed out to him that information put in so particular a form could not easily be used again; if the knowledge just gained were to serve him again and again in the future he must generalize it: eventually the class worked out the theorem, 'If two sides of a triangle are equal, then the angles opposite these sides are equal.' Within a week after this incident this surprising sequel occurred

* Walker, Helen M., *Mathematics Teacher* (Jan., 1925) p. 50. By permission.

in one of that English teacher's own classes. They were reading *Silas Marner* and one of the boys offered as his explanation, 'Silas was accused of taking money he hadn't stolen, so he just ran away. But it didn't do him any good.' At once a girl who had been in the geometry class spoke up saying, 'That isn't the way to put it. You can't use this knowledge anywhere else if you make it a special case. You have to say it this way, "When one is falsely accused of committing a crime, it is useless to try to escape by running away."' "

Keeping Proper Balance between Generals and Particulars. "If valuable learning, then, involves both particulars and generalizations, teaching may fail in two ways. Either there may be too much consideration of unrelated particulars with little or no attention given to significance; or there may be a neglect of particulars and too much repetition without understanding of the generalizations of others. So the successful teacher must pay attention to both particulars and generals, keeping a proper balance between them.

"The trained mathematician revels in generalizations, but is often not understood because he neglects basic and illustrative particulars. Some experience with particulars is necessary to true comprehension of generals, in fact the ability to give particular illustrations of general notions is a test of real comprehension. When your students find textbook statements so general as to be vague, do you find them naturally seeking understanding through consciously going back to familiar particulars? My students need continual urging to present illustrative particulars. On the other hand, after discussing, discovering or proving facts, do you find your students mentally uneasy and dissatisfied until they have worked out some significance, meaning or application of the new facts? What reaction do you get when you ask your students what they have learned in working the problems of an assignment? I find that too many of my students do not meditate enough on their work; they do not naturally seek for significance and need much pushing to get them to make good generalizations. They seem to work problems just for answers, unconcerned over what they have learned or over the meaning of their answer. In practical life, of course, the correct answer is the important thing, but in the learning stage the significance of method and result is likewise most important."

Application to Algebra. "In learning algebra, for instance, there should be much meditation on it beyond simply getting answers, for meditation results in necessary generalization which makes the knowledge useful. Students who can work exercises in a text where problems are carefully classified and where model solutions may be followed, often cannot solve miscellaneous problems because they have not generalized methods; many cannot make the common transformations and reductions because they have learned no rules. Mere drill in technique of symbolic manipulation is useless unless final general rules or theorems result. Some teachers want rules printed in the text, but most successful teachers I think prefer that their students make their own rules, realizing, however, that students need continually to be directed and urged to generalize their methods and their results.

"The author believes that teachers are failing to train students to generalize, else why do students react so poorly when asked for rules of procedure, descriptions of general methods and summaries of chapters, books, or fields of study? The importance of habits of generalization in education has been emphasized in many places in the literature. Judd gives an excellent discussion of generalized experience. Whitehead remarks: 'We cannot think in terms of an indefinite multiplicity of detail; our evidence can acquire its proper importance only if it comes before us marshalled by general ideas.'* Dewey says 'The measure of the value of an experience lies in the perceptions of relationships or continuities to which it leads up'; † his discussion of valuable experience is most suggestive to teachers. Dewey in another place says: 'Only as general summaries are made from time to time does the mind reach a conclusion or a resting place; and only as conclusions are reached is there an intellectual deposit available in future understanding; when a topic is to be clinched so that knowledge of it will carry over into an effective resource in further topics, conscious condensation and summarizing are imperative.' ‡ Both Dewey and Bode in numerous places have emphasized the great value of general notions rich in suggestive

* Whitehead, *Atlantic Monthly* (August, 1925), p. 204. By permission.

† Dewey, John, *Democracy and Education.* By permission of the Macmillan Company.

‡ Dewey, John, *How We Think.* By permission of D. C. Heath & Company.

meanings. James's story of his struggle with his smoking lamp and his discussion of generalization are classic."

[Lytle, E. B., "Generalization," *Mathematics Teacher*, Vol. XXII, pp. 18–21.]

The teacher engaged in class-room work has a splendid opportunity of making psychological observations at first hand. The next selection is a report of such observations. Geometry is so closely allied to logic that noting the errors of pupils in respect to logical principles may throw considerable light on the kind of help teachers should give to their pupils.

3. FALLACIES IN REASONING MADE BY PUPILS IN GEOMETRY

"The errors in reasoning made by our pupils in geometry might be grouped roughly under three classifications as follows:

"(1) *Assuming the Converse.* This error goes back even as far as Pythagoras, for he thought that the converse of every proposition is true. An effective way that I have used in presenting the idea that not every true statement is reversible is to present to the class the following statement and ask whether it is true: 'A horse is a four-legged animal.' Now reverse it in the form 'Every four-legged animal is a horse,' and ask the same question. This simple discussion is needed when the class reaches the proposition, 'If two angles of a triangle are equal, the sides opposite these angles are equal.'

"(2) *Reasoning in a Circle.* This is a frequent source of error. It usually consists in assuming in the proof the very thing the pupil is trying to establish. It is well to guard against this error early. This can be done by presenting to the class a proof involving this error and having the class criticize the proof. Reasoning in a circle also occasionally (particularly in the case of repeaters) takes the form of using in the proof a proposition that occurs later in the sequence and thus has not yet been proved.

"(3) *Making Use of a Non Sequitur in the Argument.* (a) One form this takes is the drawing of conclusions from a special figure. For example, the pupil may draw an equilateral triangle when a scalene triangle is called for, or a square instead of an irregular quadrilateral or instead of a more general parallelogram or rhombus. It is well to work out with pupils in advance

as part of the introduction to demonstrative geometry the idea that the given data rather than the figure should be the basis for argument. (b) Pupils in trying to prove triangles congruent sometimes try to use two sides and an angle which is not the included angle. (c) In giving a reason for the equality of two angles which lie in different triangles, pupils sometimes quote the proposition, 'If two sides of a triangle are equal, then the angles opposite the equal sides are equal.' (d) Pupils in drawing construction lines are inclined to 'overwork the line.' They assume that certain things follow from a construction that do not follow from the construction. This error is usually first met when the class comes to the first proposition on isosceles triangles. This error should be prepared for in advance by a series of exercises."

[Sharwell, T. P., "Common Fallacies in Reasoning Made by Pupils in Geometry," *School Science and Mathematics*, Vol. XXVII (1927), pp. 616–617.]

It has already been pointed out in former chapters how important it is to know the common errors that pupils make, and to understand the psychology of such errors. The concluding article of this chapter applies some well-known psychological principles to the discovery of the reasons for certain mistakes that frequently arise in connection with work in algebra.

4. PSYCHOLOGY OF ERRORS IN ALGEBRA

"Ask a teacher why one of his pupils is doing poorly in algebra and you will receive one of three answers: that the pupil is stupid, or that he is careless, or that he is lazy. Whichever of these answers you receive is probably correct, but not very helpful. A teacher who thinks of his poorer pupils as stupid, careless, or lazy does not hold the key for remediation. If the boy is stupid, no remedy can cure him. Better teaching may make a little improvement in his accomplishment, increased motivation may lead to slightly greater achievement, but the net result will be meager and unsatisfactory. Success in algebra does not come to the stupid boy—we find this evidenced in the high correlation which we find between algebraic ability and intelligence."

Types of Errors in Algebra. "Likewise the teacher who diag-

noses a cause of failure merely as carelessness, or as laziness, is not likely to do much in preventing such failure. The boy who fails in algebra does so because he does not do the examples. The boy who fails, fails because when confronted with an examination paper he has not become able to manipulate the problems so as to come out with the 'correct answer' or even to reach any answer. Somewhere along the line he goes astray, he does the wrong thing—or is unable to do anything. In short he makes errors. Rugg and Clark in *Scientific Method in the Reconstruction of Ninth Grade Mathematics* divide errors into two groups: (1) accidental errors, and (2) recurring errors. By accidental errors these authors refer to errors of reading, writing, following directions, arithmetic, etc. Speaking precisely, these are no more accidental than any other kind of error, and after sufficient search, a satisfactory explanation can almost always be given in the individual case. 'An accidental error is probably due to intermittent concentration, to lapses of attention, to instances of mind-wandering . . . one of the fundamental causes of failure in any school study is mental inertia and its accompanying weakness—mind-wandering, day-dreaming.' The remedy for this is a more spirited class hour with little opportunity for this scattered attention. The common practice of having examples already worked by the class put on the board and read aloud for the benefit of a minority who need to see the steps undoubtedly is a factor in building this habit of mind-wandering.

"But more important for our present consideration are the recurring errors. By these the teacher means errors that a boy consistently makes. They are definitely formed habits, but wrong habits. Rugg and Clark have listed 44 such errors as they have found them to occur in their standardized tests. It is our purpose to show the psychology of these errors, and from this to point out methods of eradicating them, or better, of preventing the formation of these wrong habits."

One Principle of Multiple Response. "Thorndike enumerates five characteristics of behavior. The first is multiple response to the same external situation. This is a grimly humorous truth in Algebra. In how many ways may a boy respond to the situation $(x^3)^4$! He may write as an answer x^7, or x, or $x^{4/3}$, or x^{81}, or x^{12}. Or consider the problem, "If one part of x is a, what is the other part?" In putting this problem to a boy I received the

following successive replies: 'one', 'it couldn't be,' 'ax', 'xa.' The teaching of algebra is made possible by the fact of multiple response on the part of the pupil. The problem of teaching algebra is: How can we ensure for ourselves the one response that we desire?''

Sources of Satisfaction in Results. ''A second characteristic of behavior is that the pupil has a set or determination in being presented with a problem—to get *the* answer. And when he has obtained *an* answer that in any way satisfies this set or determination, he is satisfied that he has *the* answer. There are three common satisfactions that determine in this way a pupil's choice of his answer. One is the social approval evidenced by the teacher or members of the class. I have found in watching boys work that for some the sole criterion for correctness is the nod or expression of the teacher. A favorable nod from the teacher is sufficient to convince this type of boy that he has not only found an answer that satisfies the teacher, but has found the correct answer, even though the answer really is wrong. A negative shake of the head will send the boy back again over his work to find his error. A perfectly neutral attitude on the part of the teacher will make the boy extremely uncomfortable, for it withholds from him his only check on his result. Such a passive attitude will often evoke a question as 'Did I do it right?' Now this reliance on approval is not wholly bad. Most of our language habits are formed by approval of the correct form and disapproval of the incorrect form. It is only that our algebra is a more individual thing than language, and we expect, indeed, for success we must have, some other means by which the pupil may determine the correct answer independently.

''A second 'satisfaction' that determines a pupil's choice of his answer is an answer with which he may compare his—the answer book or key. The argument against keys is that the pupil will misuse them and will obtain the result in unfair ways. That is, we expect the pupil not only to get the answer but to do the work of getting it, and usually in a prescribed way. But this objection is valid only where the work is defined as doing such and such exercises. Give a boy an assignment, 'Pass in examples 1–12 on page 86 for to-morrow,' and there is every incentive to copy or use books wrongly, but give a boy an assignment such

as, 'Practice these until you can get 12 right in 6 minutes,' and the motive for improper use of the answer book is gone.

"But somehow we expect our mathematicians to be more independent than this in determining correctness of answers. So a third and more intrinsic satisfaction is that of checking the answer. We all know these checks—after subtracting, adding the difference and bottom number to make the top number, multiplying the divisor and quotient to make the dividend, multiplying the factors to make the number to be factored, substituting the value of the unknown in the equation, substituting any number for the letters in a long and involved identity, etc. Almost all algebraic processes are either thus reversible, or may be checked by substituting. We sometimes think that checking is a troublesome and burdensome 'extra' process which takes away time from the real drill at hand, but substituting the value of x in a literal equation often gives as difficult a process as the original solution. We should bear in mind that we must give the pupil some way of determining the correctness of his answer; if not teacher approval or keys, then we must allow the pupil the confidence that comes from checking.

"Finally, with experience comes a divination of the fitness of an answer—as to the degree or dimensions of the answer, we have the feel as to whether the answer is .01 or 100.

"Before leaving this topic we should consider one potent method a boy has of testing the correctness of his answer—namely, whether it comes out even or not. Early in his course, if it has not already been acquired in arithmetic, he becomes suspicious of any answer that does not come out even. In connection with algebra inquiry, Mr. Orleans has made counts in nine texts in present use, to determine the number of answers that are integers, fractions, decimals, surds, or imaginaries. Following is a tabulation of his results expressed in percentages:

	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*Total*
Integer	62.6	63.7	49.4	61.1	43.0	71.7	59.1	58.1	71.7	59.4
Fraction ...	15.7	19.7	14.6	15.6	13.4	23.4	14.2	15.1	10.6	15.4
Decimal	20.7	0.1	18.6	17.6	40.4	4.1	17.1	9.0	6.7	15.8
Surd	1.1	7.5	13.2	5.7	3.2	0.8	7.7	15.3	9.1	8.1
Imaginary ..	0.0	0.0	4.2	0.0	0.0	0.0	1.9	2.4	1.8	1.4

"In any practical problem that a boy will ever meet, the chances are against 'coming out even.' Harvard College recognized this fact in its old entrance examinations and used to insert a quadratic equation with roots coming out 'uneven.' It is a bad habit to fix—that of judging the correctness of an answer by its 'coming out even'—but no change can be made using our present texts unless teachers demand it."

The Pupil's Set. "While considering the second characteristic of behavior (i. e., mental set or determination) one must not ignore the fact that sets other than that of obtaining the correct answer are present. Of special significance are those more enduring sets that a pupil has with regard to his algebraic ability as a whole. The set or attitude—'I can (or cannot) do algebra,' 'I do (or do not) like mathematics' and the like—are of great importance in determining the character of work in algebra. It is likely that nearly all the attitudes can be traced back to some signal occasion of success or failure. The boy that is suggestible to the extent of believing that $(x^3)^4 = x^7$ by receiving a favorable nod from his teacher is suggestible to the extent of believing that he is a failure in algebra if he receives 'E' on his first quarter's report. In so far as our marking system is reliable, this is a good thing—it discourages the unfit from proceeding with the to them impossible. But since our marking system is so grossly unreliable as we know it to be, this undoubtedly discourages many otherwise hopeful cases.

"Some may object to the statement that the set of a pupil on being presented with a problem is 'to get the answer'—they would like to have it 'to pass the term's work,' or 'to learn algebra,' or some more distant end. It is true that these more ideal or distant ends may be the more controlling attitude or determination of the more intelligent or sagacious pupils, but for the great majority the set is immediate and direct, to be satisfied immediately and directly. If the more distant aims are to be built up, they must be built up by training as must any other habit."

The Principle of Partial Response. "A third characteristic of behavior is the partial response to a situation. This is a very common phenomenon in algebra—it partly is what prescribes a certain response instead of the multitude of others that might be made to any example. Usually it is clearer to think of it as

the prepotency of certain elements of a situation. To take a concrete example, consider the familiar:

$$5x^2 + 16x + 3 = (5x + 3)\ (x + 1)$$

Here the boy obtains 5x and x to multiply to give $5x^2$; and 3 and 1 to multiply to give 3; and having obtained an answer, is satisfied. We must not necessarily convict the boy of forgetfulness. He is in much the same situation as the young teacher before his first class confronted by a room full of wide-awake youngsters, and also by a subject matter which must be organized, and by the details of class-room management such as distributing papers, attending to ventilation, keeping records, etc. Would we convict our young teacher of forgetfulness if he failed to attend to the ventilation in his early training? Rather he has expended his maximum attention on details of teaching. So our boy in the example above may have struggled so in getting his results that the fact of the cross products escaped him altogether." . . .

Response by Analogy. "A fourth characteristic of behavior is what Thorndike calls 'response by analogy.' In any new situation one responds as he would respond to the situation most nearly resembling it in his past experience. Errors in algebra illustrate this. Consider the following:

$$x^2 - 81 = 0$$
$$x = 9$$

In linear equations, the result comes out x = something and the single value of x is a satisfactory result; consequently in quadratic equations the natural first response is to be satisfied with a single value of x. This error is also seen when a solution for a single letter is considered sufficient in solving simultaneous equations. Indeed, nearly all cases of unfinished examples can be traced back to a previous process where what is now a step in our unfinished example was then the final result. Even the answer $-x = 12$ can be so explained. Usually the pupil has his solution on dividing by the coefficient of x, i. e., $6x = 72$, $x = 12$, and consequently when he has divided by the coefficient 6 in $-6x = 72$, he has the cue that he has finished the example. . . .

"This analysis of errors makes prominent the fact that learn-

ing algebra is an extremely complicated process. No wonder it often seems like juggling letters. When a definite response has been made to a combination of letters and symbols, we may expect this response to persist until a definite effort towards change is made in it. Oftentimes these errors show how well previous processes have been learned. They surely show us how we have failed in emphasizing those elements of a problem that require a new or different response."

Associative Shifting. "A fifth characteristic of behavior is associative shifting, the learning process itself. Out of the number of various responses that a pupil may make when confronted with a given problem, that one is selected which gives its satisfaction in the form of teacher approval, or correspondence with the answer in the answer book, or verification by checking, or fitting in with other known algebraic and quantitative facts. And by drill and repetition, these correct responses become definitely established habits."

Perseveration. "A sixth characteristic of behavior—perseveration—is extremely important to explain certain of the so-called 'accidental' errors. By perseveration is meant 'a tendency to repeat an act time after time, when once it has been aroused by some appropriate stimulus. . . . Perseveration is most apt to lead to recall of recent experiences, and is most apt to appear when attention is relaxed, and the mind allowed to run freely. Instances of perseveration are found in the running of a tune in the head, soon after it has been heard; or in the flashing of a scene before the mind's eye soon after it has been actually seen; or in the reminiscences of the day which are apt to come to mind as one is dropping off to sleep.' This perseveration is apt to occur in algebra whenever the pupil is not working at top notch enthusiasm, or when he is disturbed in any way by other trains of thought, be they relating to outside activities or to what is going on in the classroom besides the problem at hand. Occasionally, however, it may result from a too great concentration upon a particular feature of a problem. Arithmetical errors like $24 \cdot 8 = 182$ are undoubtedly explainable in this way—$8 \times 4 = 32$, and the 2 perseverated to the exclusion of the 3 and is combined with the $2 \times 8 = 16$." . . .

Anticipation. "I believe a seventh characteristic of behavior can be found which we may call anticipation. By this we mean

the focusing of the attention on some element ahead of the writing in the process, which causes the reaction to occur before it should. This is the familiar error in speech when one says 'prace rejudice' for 'race prejudice', or 'the stars have carted' for 'the cars have started,' or 'fight the lires' for 'light the fires.' This comes usually at a time of special mental stress or mental eagerness—but as in perseveration, the attention is diverted from the mechanical reaction of speech in the present. It is hard to point out actual errors in algebra due to this cause—they are always 'accidental' errors. Errors of reading, writing, and arithmetic may come under this heading. This phenomenon undoubtedly is a large factor in causing careless errors in examinations. For though the eagerness usually felt in an examination could not be called day-dreaming or mind-wandering, it might divert the attention from the specific process at hand."

Application of These Principles. "The outcome of this psychological analysis of errors in algebra is that it enables us to improve our teaching in a way that epithets of 'stupid,' 'careless,' or 'lazy' can never do. In the first place, it shows us the need for a psychological analysis of algebraic processes into the constituent connections or bonds involved. Especially those bonds that require a different response than in previous processes need analysis in order to receive emphasis in future teaching and drill. x^2x^7 without teaching would perhaps receive the answer x^{14}, because the customary thing to do when multiplying is to multiply the numbers on the scene. To add these exponents and obtain x^9 is an entirely new response in connection with numbers used in a multiplication process.

"In the second place, our analysis of errors shows the need for drill or practice in various processes. Telling a boy what things to do does not form habits of doing them. The teacher ought not to expect that his explanation of a process is going to guarantee that the process is learned or a habit formed until the pupil has had a certain amount of drill on the process, not in fact until a test shows certain proficiency in that process. Drill or practice is the remedy for attention to certain elements of an example to the exclusion of certain other elements. Not until certain processes become automatic can we expect the attention to be free to take in all the different steys needed in a solution. So the boy who omits the minus sign in solving $7x = -25$ needs more

drill on short division so that the division will come automatically and attention can also take in the minus sign.

"Whether we ought to attack a process like addition of fractions by learning many specific elements of the process, gradually combining and building up, or whether we should plunge the pupil at once into the final process is still in doubt. It has been demonstrated that in learning poetry, nonsense syllables, etc., the whole method is superior to the part method. Poetry is a set of serial bonds, and usually there are no interferences from past connections to contend with. But algebra not only means the building up of a series of bonds, but bonds, some of which have facilitations from processes previously learned, and some of which have inhibitions from processes previously learned. There must be differential drill, with more emphasis on those connections that are hindered by past responses, and relatively less emphasis on those connections that are helped by past responses. The wise teacher will provide special drills of this propædeutic nature.

"Since much drill is necessary, and since only correct responses help build up correct habits, one should provide drill material that actually induces repetition of correct associations. I am referring to the custom of giving pupils a few difficult examples to do instead of many easy ones. . . .

"In the third place, since accidental errors are largely due to mind wandering, our psychological analysis shows the need for a reorganization of our classroom procedure. We need to develop, as Rugg and Clark say, a 'spirited atmosphere' in the classroom. This is possible by (1) timing all formal activities. Work should be done under pressure. But to complement this, Rugg and Clark show that we need (2) rapid shifts in the type of mental processes involved. Instead of dragging through the whole hour on the involved difficulties of one topic, it is better to vary the work, giving part of the time to rapid review drill, and part to the taking up of some new topic."

Meaning Comes with Experience. "In closing, let me say a word in regard to the criticism that will undoubtedly be raised with regard to this psychological analysis of errors: that no allowance has been made for the reasoning capacity of the pupil. A child who makes the mistake $-4(3x-4) = -12x-16$ is stupid or careless, they say, because the function of the parenthesis is to distribute operations to everything within it. And so all errors offend

the teacher's sense of the meaning of algebraic symbols. But let us not forget that we who teach mathematics know the very things that our pupils do not know. We see these mistakes to be inconsistent, because we have learned the meanings and use of the symbols and see their interrelations—they do not see them to be errors because they have not learned the meanings of the symbols and do not comprehend their significance. Meaning comes with experience, and things take a significance after we have become adjusted to them. We as teachers have been assuming that our pupils acquire these meanings and relationships and apply them in their processes and manipulations. Psychology teaches us that the opposite is really the truth; our pupils first learn to carry out the processes and manipulations, and thereby acquire the meaning and significance of what to do."

[Symonds, P. M., *The Psychology of Errors in Algebra*, "The Mathematics Teacher," Vol. XV (1922), pp. 93–104. By permission.]

QUESTIONS

1. What is mechanical memorizing? Why is it undesirable? How is it to be avoided?
2. What is meant by formalism in education? How is it to be avoided?
3. Discuss the application of the psychology of mental imagery to the study of solid geometry.
4. Explain: "To be useful, knowledge should be generalized."
5. Discuss the relation between knowledge of particulars and of generals.
6. Show the character of each of the logical fallacies most common in a pupil's reasoning concerning geometry.
7. Describe each of the seven characteristics of behavior enumerated by Symonds, and show how they give rise to pupils' errors.

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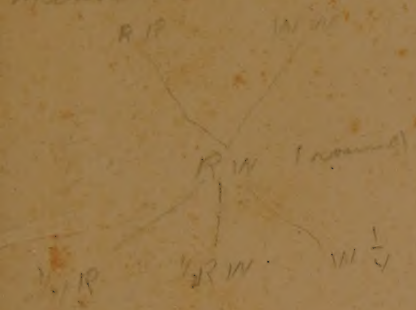

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